

Appendix 1: American Academy of Cerebral Palsy & Developmental Medicine - Levels of Evidence (December 2008)²¹

Level	Group Intervention Studies	Single Subject Research Designs (SSRD)
I	Systematic review of RCTs Large RCT (with narrow confidence intervals) (n>100)	Randomized controlled N-of-1 (RCT) Alternating treatment design (ATD) Concurrent or non-concurrent multiple baseline design (MBD) (Generalizability if the ATD is replicated across three or more subjects and the MBD consists of a minimum of three subjects, behaviors, or settings. These designs can provide causal inferences.)
II	Smaller RCTs (with wider confidence intervals) (n<100) Systematic reviews of cohort studies “Outcomes research” (very large ecologic studies)	Non-randomized, controlled, concurrent MBD (Generalizability if design consists of a minimum of three subjects, behaviors, or settings. Limited causal inferences)
III	Cohort studies (must have concurrent control group) Systematic reviews of case control studies	Non-randomized, non-concurrent, controlled MBD (Generalizability if design consists of a minimum of three subjects, behaviors or settings. Limited causal inferences)
IV	Case series Cohort study without concurrent control group (e.g., with historical control group) Case-control study	Non-randomized, controlled SSRDs with at least three phases (ABA, ABAB, BAB, etc) (Generalizability if replicated across three or more different subjects. Only hints at causal inferences.)
V	Expert opinion Case study or report Bench research Expert opinion based on theory or physiologic research Common sense/anecdotes	Non-randomized controlled AB SSRD (Generalizability if replicated across three or more different subjects. Suggests causal inferences allowing for testing of ideas.)

Abbreviations: RCT = randomized controlled trial; SSRD = single subject research design

Appendix 2: Evidence Table for Studies Reviewed

Appendix 2: Evidence Table for Studies Reviewed						
Citation	Design	Sampling Subjects	Outcome	Measure	Outcomes ICF Component	Results/Findings
Level II Evidence						
Jones et al., 2012 ²⁵	RCT	14 matched pairs of children with disabilities aged 14-30 mo. Subjects used PMD for 12 mo.	Independent control Developmental change	Butler et al.'s ³¹ list of driving skills BDI PEDI	BSF Activity and Participation	Basic driving skills in 12 - 42 weeks Increased BDI receptive language scores Increased PEDI functional mobility skills Decreased PEDI caregiver assistance in mobility and self-care domains No difference between subjects' and controls' motor skills
Level III Evidence						
Butler, 1986 ²⁶	MBD (SSRD)	6 children, 23-38 mo with disabilities PMD use - 1-3 weeks	Effect on self-initiated exploratory behaviors	Target behaviors coded from video recordings	Activity and Participation	All increased self-initiated movement. 3 children increased communication. 3 children increased interaction with toys
Level IV Evidence						
Bottos et al., 2001 ²⁷	Before and after case series	25 children aged 3-8 yr with CP using a PMD for 6-8 mo	Effect on IQ, motor level, independence and driving ability	GMFM COPM PMP	BSF Activity and Participation	Increased independence. 21/27 able to drive (7/13 with IQ below 55) No change in motor abilities
Deitz et al., 2002 ³⁰	ABAB design (SSRD)	2 preschoolers PMD 3-4 hrs total use	Affect; self-initiated movement; initiation of contact with others	Target behaviors coded from video recordings	BSF Activity and Participation	Increased self-initiated movement Impact on initiation of contact with others. No effect on affect
Guerette et al., 2012 ²⁹	Before and after case series	13 children, with CP (18 mo-6 yr.) 10 children with physical disabilities (18 mo-3.5 yr). 4-6 months PM use	Social skills Play skills	ASBI PKBS	BSF Activity and Participation	Improved social skills. Increased self-esteem, self-confidence and composure Improved level of play skills
Tefft et al., 2011 ²⁸	Before and after case series	13 children with CP 18 mo - 6 yr. 10 children with other physical disabilities 18 mo - 3.5 yr. 4-6 mo PM use	Impact on parental stress, negative emotions, perceived social interactions and parental satisfaction	Parental Stress and Support Checklist MATCH Survey of Technology Use QUEST	BSF Activity and Participation Environmental factors	Increased satisfaction with child's play and social skills, ability to go where desired, sleep/wake pattern and belief that the public accepts their child. Increased interactions within the family at time of wheelchair delivery.

Citation	Design	Sampling	Outcomes			
		Subjects	Outcome	Measure	ICF Component	Results/Findings
Level V Evidence						
Butler et al, 1983 ³²	Descriptive/ Case studies	9 children, (20-39 mo) with physical disabilities PMD use 1-7 weeks	Achievement of driving skills	Parent descriptions of achievement of 7 driving skills	Activity and Participation	8/9 children were able to drive within 1.7 – 12 hrs of driving practice time
Butler et al., 1984 ³¹	Descriptive/ Case studies	13 children 20-37 mo physical disabilities	Achievement of driving skills	Study-specific list of driving skills	Activity and Participation	12 children learned to drive in an average of 16 days (range 3-50 days)
Everard, 1984 ³⁷	Case study	1 child 22 mo with SMA	Achievement of driving skills Developmental change	Parent description	BSF Activity and Participation	Able to drive in 6 weeks. Increased interaction and participation with peers Increased assertiveness and confidence
Galloway et al., 2008 ³⁹	Case studies	14 mo. with Down syndrome. 6 sessions. Specialized PMD	Achievement of driving skills	Time driving, path length, # and activation duration	Activity	Increased time spent driving, total path length, # of joystick activations and duration of joystick activations
Jones et al., 2003 ³⁸	Case study	20 mo. with SMA PMD use 6 mo.	Achievement of driving skills Developmental change	Butler et al.'s ³¹ list of driving skills BDI	Activity and Participation	Able to drive within 6 weeks Developmental gains in all domains of BDI over 6 months
Lynch et al, 2009 ⁴⁰	Case study	7 mo. with spina bifida Specialized PMD – 5 mo	Goal-directed use of power mobility Developmental change	Path length, goal achievement, # activations, Bayley III	BSF Activity and Participation	Increased joystick activation, distance and goal-directed driving. Greater than anticipated developmental gain, especially in cognitive and receptive language skills.
McGarry et al., 2011 ³⁵	Case studies	4 children w/ CP (4-14 yr,) GMFCS Level V. 16 sessions, 2 x wk Smart Wheelchair	Mobility skill development Behavioral change	PMP Field notes Parent interviews	BSF Activity	3/4 children increased independence in ≥ three driving skills. 4 th child with verbal prompts 3 /4 mothers reported change in child's confidence, motivation and affect.
Nilsson et al., 1999 ³⁴	Case studies	17 typically developing infants followed from 3-12 mo. of age 40 children and	Identify development of cause-effect in relation to use of toys, computer and PMD	Video recordings, field notes, in-depth interviews	Activity	1. Cause-effect emerges first in PMD 2. Cause-effect with single switch and separate toy. Emergent joystick directional control 3. Functional use of PMD

Citation	Design	Sampling Subjects	Outcomes			
			Outcome	Measure	ICF Component	Results/Findings
		adults with PCD				4. Computer mouse use
Nilsson et al., 2010 ⁴⁴	Quantitative analysis of data from larger study	45 children and adults with PCD	Factors significantly associated with achievement of control of steering	Descriptive data of participants and training environment	Activity	More than 30 training sessions (p= 0.004) Training at two or more locations (p= 0.0007) Training for longer than 2 years (p=0.016) More training with professional (p=0.045)
Paulsson & Christoffer-son, 1984 ³³	Case studies	12 children with disabilities, 2 ½ -5 years of age	Changes in motor development	Therapist and parent observation	Activity and Participation	Increased arm, hand, head and trunk control.
Ragonesi et al., 2010 ⁴¹	Case study	3-yr-old with CP using specialized PMD in preschool classroom. Compared 10 days without and 13 days with PMD.	Classroom mobility and socialization	Most active 30 min/day analyzed. Counted # min: driving, parallel play; teacher; and peer interaction	Activity and Participation	Mobile 5-10% time - peers mobile most of the active 30 mins Baseline – significantly less interaction time than peers, more time solitary /parallel play Intervention phase – less time in parallel play, slightly more time interacting with teachers and more time interacting with peers
Wiat et al., 2003 ⁴²	Cross-sectional/ survey evidence	66 participants who received PMD before 18 yr. of age. 52 completed with parent/caregiver proxy	Extent, locations, barriers and facilitators of PM use.	Structured telephone interview.	Activity and Participation	Physical barriers adversely affect PM use. Most common barriers: transportation and difficulty using PMD in the home PM allowed freedom and facilitated play with peers
Zazula & Foulds, 1983 ³⁶	Case study	Child with phocomelia	Independent steering	Description	Activity and Participation	Able to steer in all directions by 18 mo. of age
Qualitative Evidence						
Evans et al., 2007 ⁴⁸	Qualitative interviews	18 persons with disabilities, 10-18 yr	User's perceptions of PMD use after 10-19 months of use	A priori interview topics based on EuroQol EQ-5D topics	Activity and Participation	Increased independence and participation in age-appropriate activities. Safety training helpful for using PMD in different outdoor environments
Nilsson &	Ethnographic	2 children (aged 4	Behavioral and	Video-recordings,	BSF	Increased wakefulness and alertness

Citation	Design	Sampling Subjects	Outcomes			
			Outcome	Measure	ICF Component	Results/Findings
Nyberg, 2003 ⁴⁶	case series	and 5 years) with PCD	developmental changes during training in PMD	field notes, in-depth interviews	Activity	Increased use of hands and arms Emergent understanding of cause-effect Increased interest in people and objects
Nilsson et al., 2011 ⁴⁹	Grounded theory	45 individuals with PCD (17 typically developing infants and 64 individuals with less cognitive disability)	The process of learning to use a joystick	Video recordings, field notes, in-depth interviews	Activity	8 participants with PCD achieved goal-directed driving or higher. Grounded theory of deplateauing Eight-phase learning process identified Assessment tool developed Strategies for facilitating learning described
Odor & Watson, 1994 ⁴⁵	Action research	13 children with physical, cognitive and sensory disabilities in three special schools	Use of the ‘Smart wheelchair’, to develop cognitive, perceptual, physical and mobility skills Explore impact of environment	Profiles compared pre- and post-study Long-term process diaries and charts Direct observation Video records and computer-based behavior coding	BSF Activity and Participation Environmental factors	All children learned new driving skills 2 children progressed to complete control over conventional joystick-operated PMD Positive influence on motivation, initiation, exploration, communication and assertiveness Supportive environment and time in chair correlated with driving ability more than physical, motor or sensory characteristics.
Wiat et al., 2004 ⁴⁷	Phenomenology	5 mothers of children with physical disabilities who use PM	Parents’ experiences and perceptions of their children’s experiences with PM	Semi-structured interviews in participants’ homes	Activity and Participation Environmental factors	PM increased personal control, independence and participation in age-appropriate activities. Positive effect on others’ attitudes. More ‘legitimate’ peer relationships.

Abbreviations: ASBI= Adaptive Social Behavior Inventory; BDI = Battelle Developmental Inventory; BSF = Body structure & function; COPM = Canadian Occupational Performance Measure; CP = cerebral palsy; EuroQOL = European Quality of Life Scale; GMFM = Gross Motor Function Measure; IQ = intelligence quotient; MATCH = Matching Assistive Technology & Child; MBD = Multiple baseline design; mo = month; PCD = profound cognitive disability; PEDI = Pediatric Evaluation of Disability Inventory; PKBS = Preschool and Kindergarten Behavior Scales; PM = power mobility; PMD = power mobility device; PMP = power mobility program; QUEST = Quebec Evaluation of User Satisfaction with Assistive Technology; RCT = randomized controlled trial; SSRD = single subject research design; yr = year.