Adaptive Standing for Children with Multiple Physical Disabilities

Presenter: Zach Huleatt, MS, PT

Objectives

- Discuss the evidence-base regarding adaptive standing for bone mineral density, hip abduction, and range of motion and hip surveillance.
- Discuss specific device features, therapeutic uses and best positioning practices for adaptive standing in the context of postural management and physical activity guidelines.

Postural asymmetries

Prolonged Posture

Tissue Adaptation

Contracture

Distortion

Postural Asymmetries in CP

Likelihood of body distortions increased

- if the child had postural asymmetries in sitting and in supine
- with higher GMFCS level
- with age

- 19.2% had knee flexion contractures
- 10.5% had scoliosis
- 8.7 % had windswept hips
- 6.6% had hip flexion contractures

Casey, 2022

Supported Standing Outcomes

- Increased or maintained bone mineral density (BMD)
- Increased range of motion (ROM) or prevention of contractures
- Maintained hip stability or prevention of hip subluxation
- Improved bowel function
- Decreased spasticity
- Increased activity and participation (activities of daily living and/or gross motor function)

McLean, 2023

Bone Mineral Density

Risk factors for osteoporosis in CP

Poor growth and nutritional status	Low calcium intake
poor sun light	Immobility
Low vitamin D	Medications that interfere with vitamin D metabolism
Lack of weight bearing	Growth hormone insufficiency

Houlihan, 2009

Fracture risk

- Children with CP at similar risk of sustaining fractures as typically developing children
- Hazard for fracture was 7 times higher in children with epilepsy
- Most fractures occurred in early childhood and after 8 years of age
  - GMFCS Levels I–III: Fractures most frequently in the upper extremities
  - GMFCS Levels IV or V and those with epilepsy: Fractures more likely in the lower extremities; femur was the most frequent site.

Granild-Jensen 2022, Linton 2022

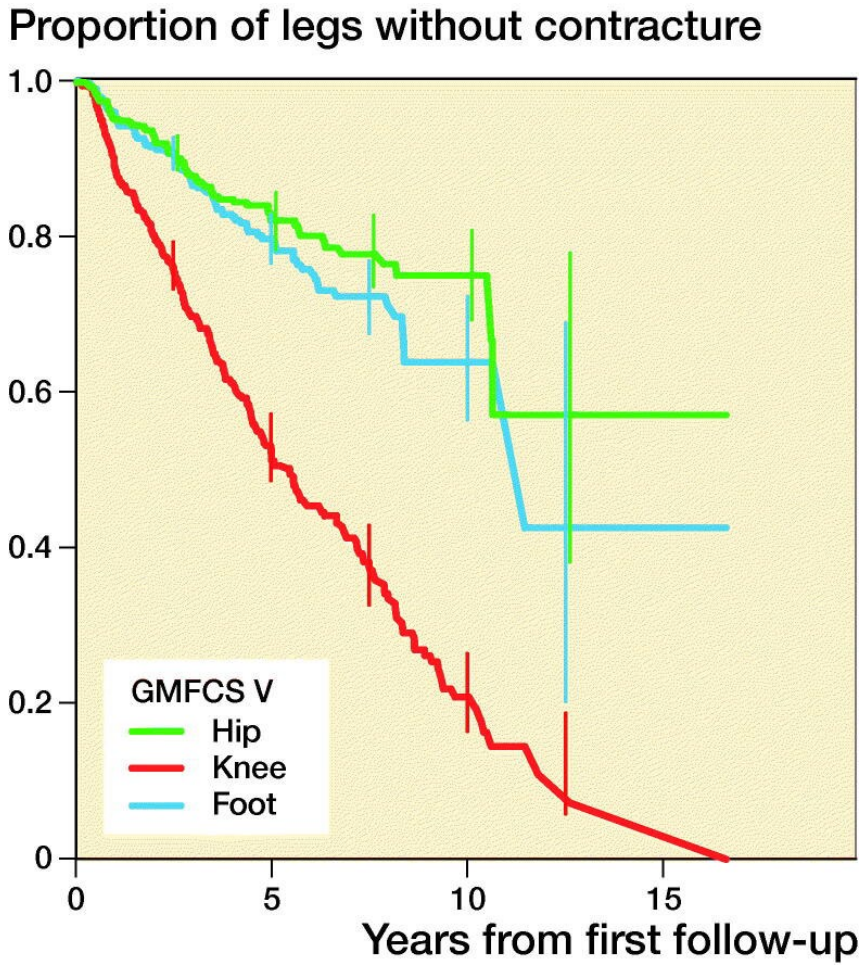
Which four variables are significant risk factors for scoliosis?

Variable/category	n = 654
GMFCS [a]	
I	264 (40)
II	117 (18)
III	53 (8.1)
IV	115 (18)
V	105 (16)
Sex	
Male	372 (57)
Female	282 (43)
CP [b] subtype	
Spastic unilateral	268 (41)
Spastic bilateral	216 (33)
Ataxic	41 (6.3)
Dyskinetic	93 (14)
Mixed type	22 (3.4)
Missing	14 (2.1)
Birthyear	
2000	113 (17)
2001	144 (22)
2002	191 (29)
2003	206 (32)
Epilepsy, yes	222 (34)
Hip surgery [c]	53 (8.1)
Worst side	
MP [d] 41–100%	45 (6.9)
Limited hip extension ≤ –5°	35 (5.4)
Limited knee extension ≤ –5°	91 (14)

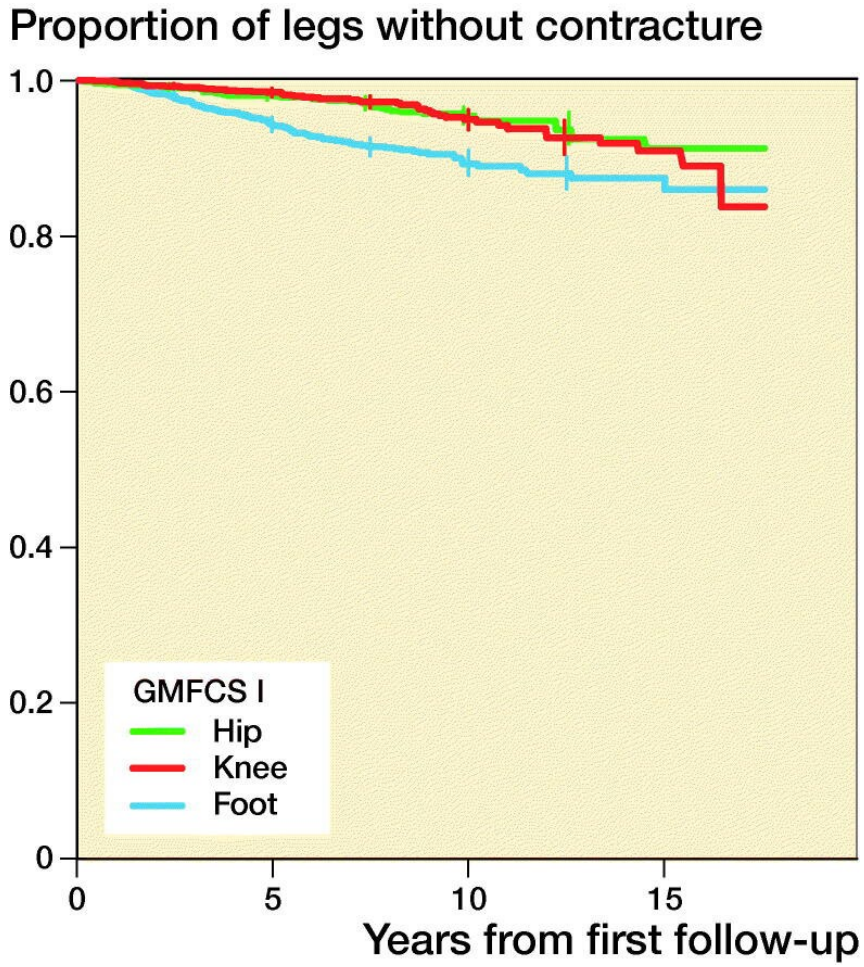
[a] GMFCS = Gross Motor Function Classification System.
[b] CP = cerebral palsy.
[c] Femur-, pelvic osteotomy, adductor psoas tenotomy.
[d] MP = migration percentage.

Pettersson 2020

Contractures



GMFCS V



GMFCS I

Cloodt, 2021

Standing and ROM

- Manual stretching is not considered effective.

  Novak, 2020

  Eldridge, 2016

- Low load, long-duration passive stretching using adaptive equipment positioning may prevent and/or reduce contractures.

  National Institute for Health & Care Excellence

  NICE Guidance, 2016

Hip displacement

- Hip displacement is the second most common musculoskeletal deformity in children with cerebral palsy.

Howard, 2023

- Adduction is the most common deformity of the hip in children with cerebral palsy. Adduction contractures can cause various difficulties, including…hip subluxation…

Agarwal, 2012

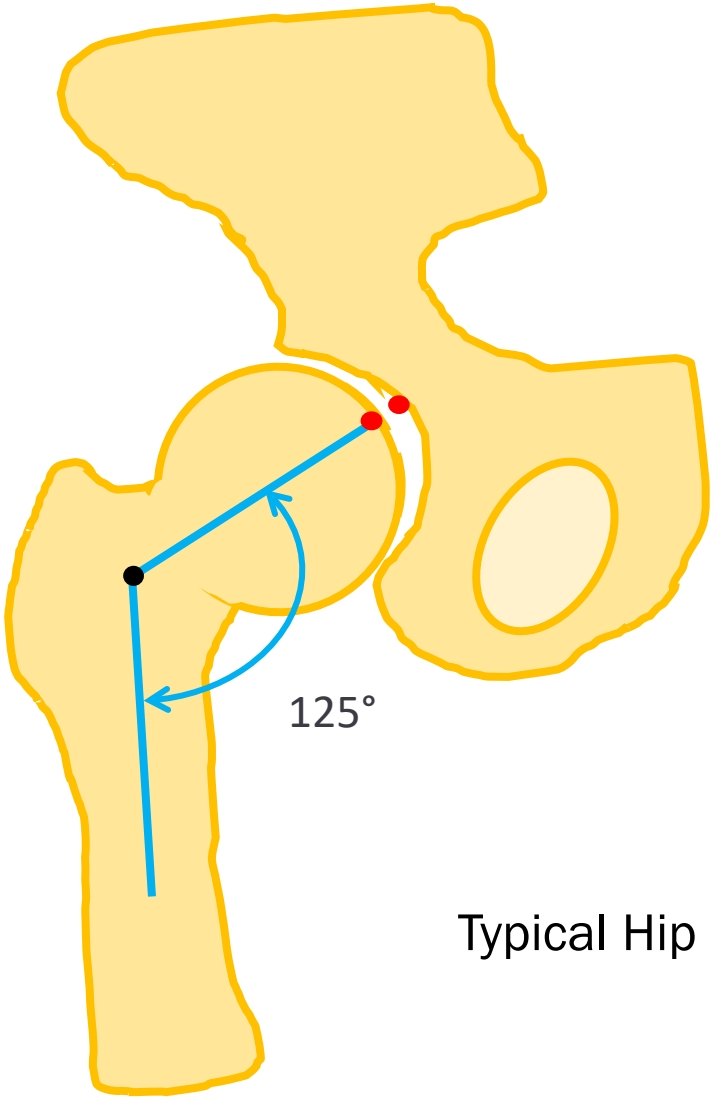
- **We have identified the need for more effective and integrated management from early childhood to skeletal maturity.**

Howard, 2023

Hip Displacement

What does the research say?

1. Predictors for hip displacement
2. Surgery and surgical outcomes
3. Abduction standing and hip displacement



Typical Hip

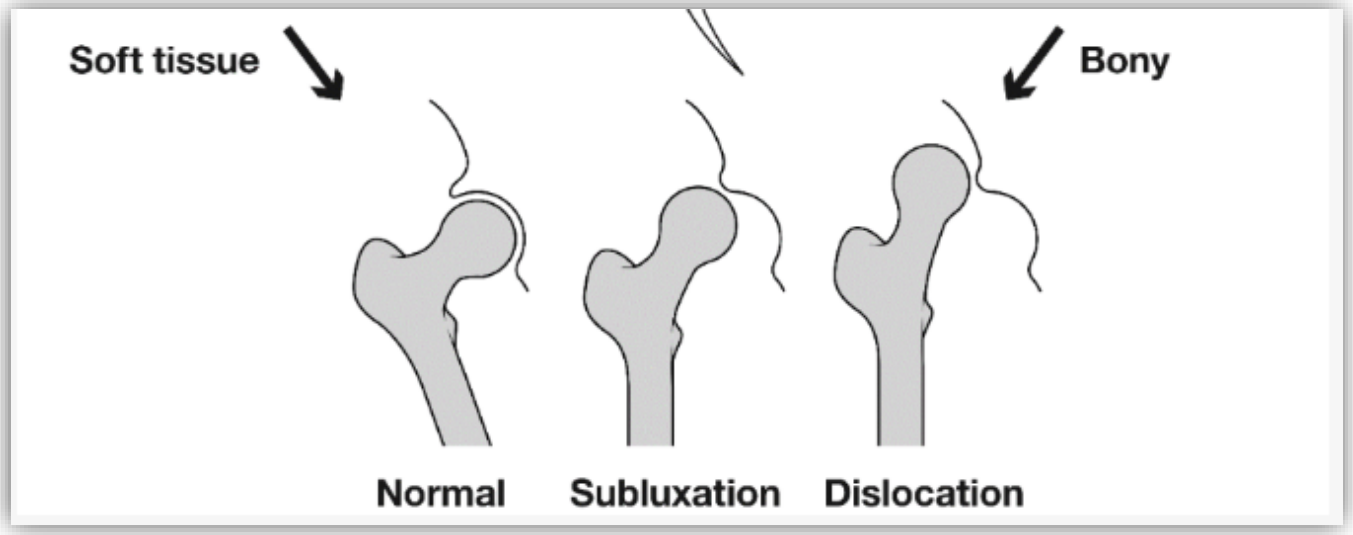
What causes increased MP?

Soft Tissue

- Adductor spasticity
- Limited abduction PROM
- Flexion contracture

Bony

- Neck-shaft angle/head-shaft angle
- Femoral neck anteversion
- Acetabular indices



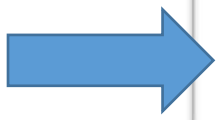
Martinsson, 2011

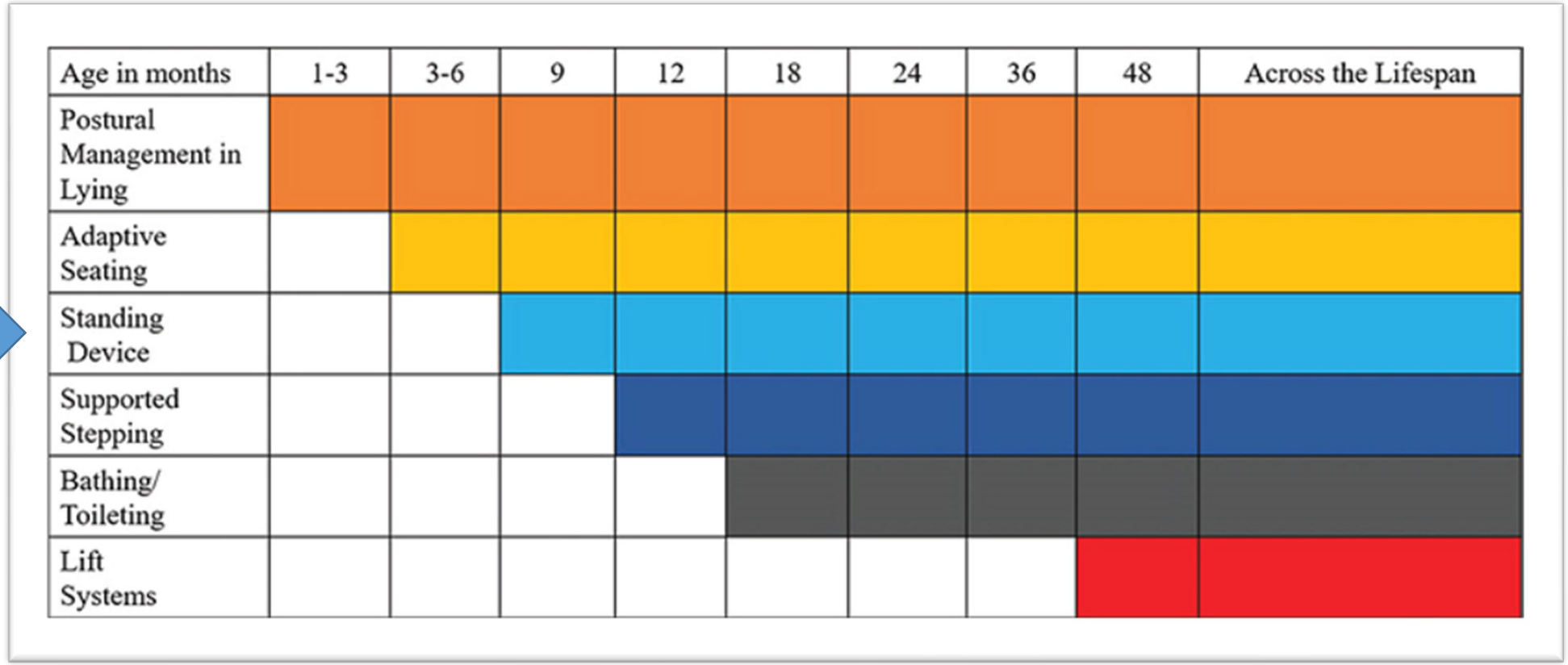
Author's Conclusion:

"Straddled weight-bearing, 1 hour per day, may reduce the MP after adductor-iliopsoas-tenotomies or prevent an MP increase and preserve muscle length in children with cerebral palsy who did not need surgery."

Paleg, 2022

Evidence-informed clinical perspectives on postural management for hip health in children and adults with non-ambulant cerebral palsy





Age in months	1-3	3-6	9	12	18	24	36	48	Across the Lifespan
Postural Management in Lying									
Adaptive Seating									
Standing Device									
Supported Stepping									
Bathing/ Toileting									
Lift Systems									

Sedentary Behavior and Physical Activity:

New Possibilities for Adaptive Standing

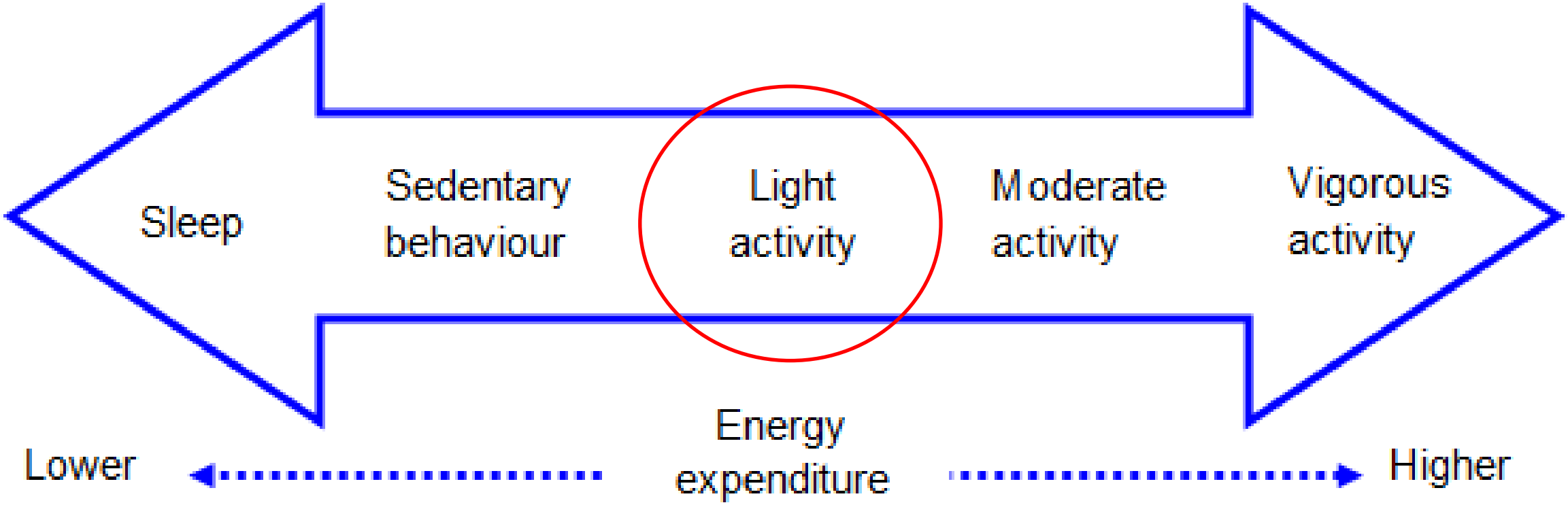
Longitudinal Trajectories of Physical Activity

From age 3 to 12 –children with cerebral palsy have an overall decrease in physical activity.

Physical activity decreases while sedentary behavior increases with increasing GMFCS Level.

Bjornson, 2020
Case, 2020
Hulst 2023

The Activity Continuum



J Pediatr. 2014 November ; 165(5): 1011–1016. doi:10.1016/j.jpeds.2014.07.027.

Muscle activation and energy-requirements for varying postures in children and adolescents with cerebral palsy

Dr. Olaf Verschuren, PhD,

STANDING IS LIGHT PA!

Mean energy expenditure is >1.5 METs during standing for all GMFCS Levels

Vershuren 2014

Operational Definitions of the Activity Continuum

Activity Level	Definition	Examples
Sedentary	≤1.5 METs[a]	Sitting, reclining
Light	1.6–2.9 METs	Walking at 2 mph, slow cycling, stretching STANDING
Moderate	3.0–5.9 METs	Walking at 3–4.5 mph, cycling at 5–9 mph
Vigorous	≥6.0 METs	Walking at ≥5.0 mph, jogging, cycling at ≥10 mph or uphill

[a] MET=metabolic equivalent of task (1 MET=3.5 mL $O_2 \cdot kg^{-1} \cdot min^{-1}$).

Verschuren, 2014

Stander configuration

- Bone mineral density: near vertical, adjust for leg-length, intentional use of accessories to assure WB
- Range of motion: initial angle adjustment to tolerance, then intentional use of accessories to achieve stretch, consider further adjustment during standing session to increase stretch
- Hip migration: legs in abduction, near vertical and intentional use of accessories to assure WB

Implementation of Adaptive Standing: Positioning Applications Product Demonstration

Thank you!

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