

Static versus dynamic standing – what to choose?

A clinical reflection on available evidence

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Made for Movement Group AS

Understand and classification of function, disability and health

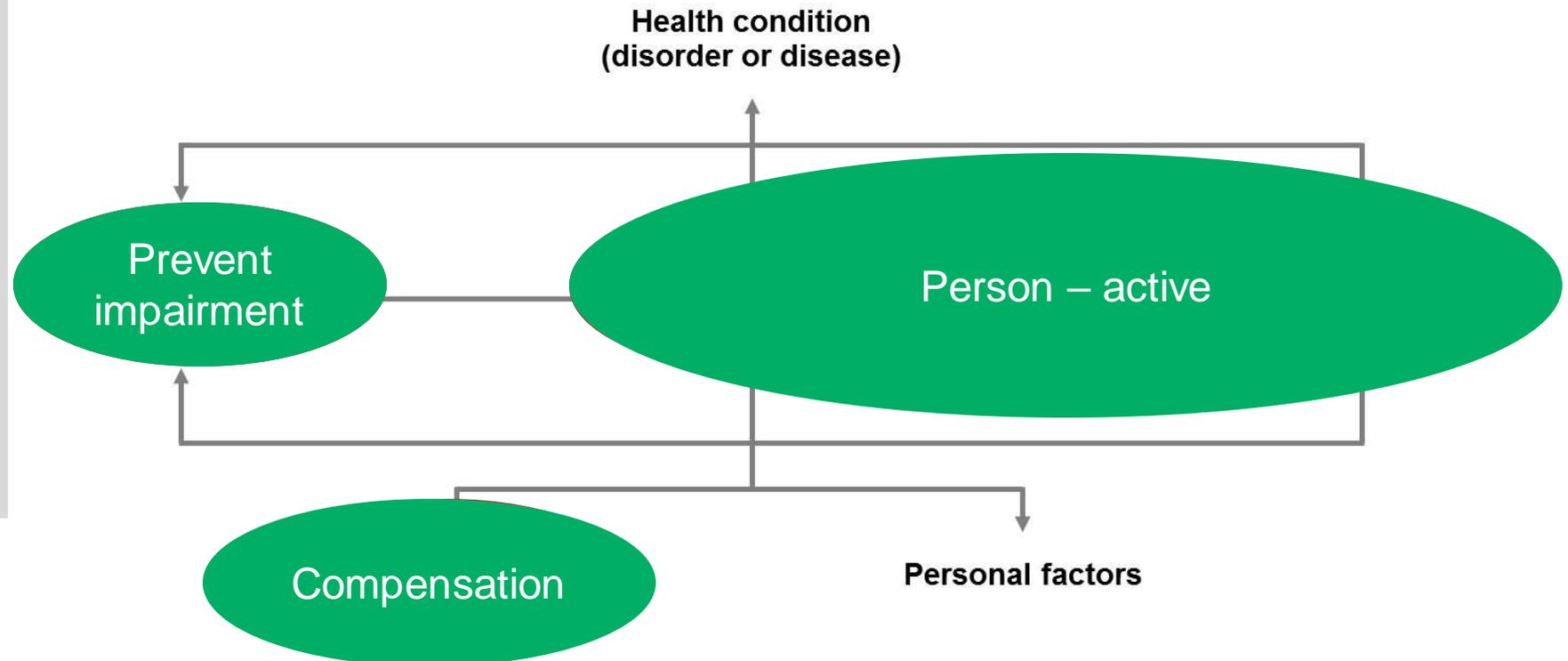
ICF

- International Classification of Functioning, Disability and Health

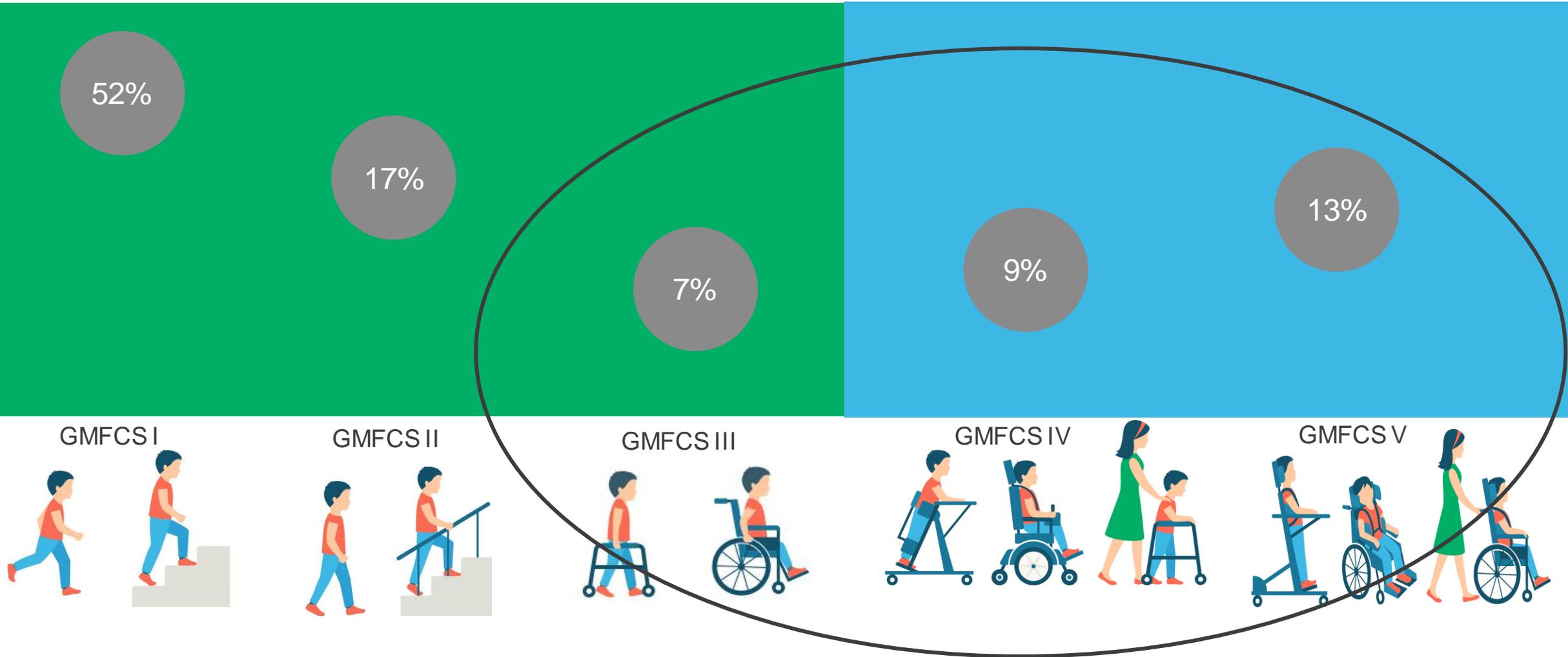
The ICF provide a scientific basis for understanding and studying health and health-related states, outcomes, determinants, and changes in health status and functioning.

It's used to define facilitators and barriers for the individual person.

Environmental factors includes assistive technology.



2 in 3 children with cerebral palsy walk



(Andersen et al., 2018; Novak, 2014)

Movement potential

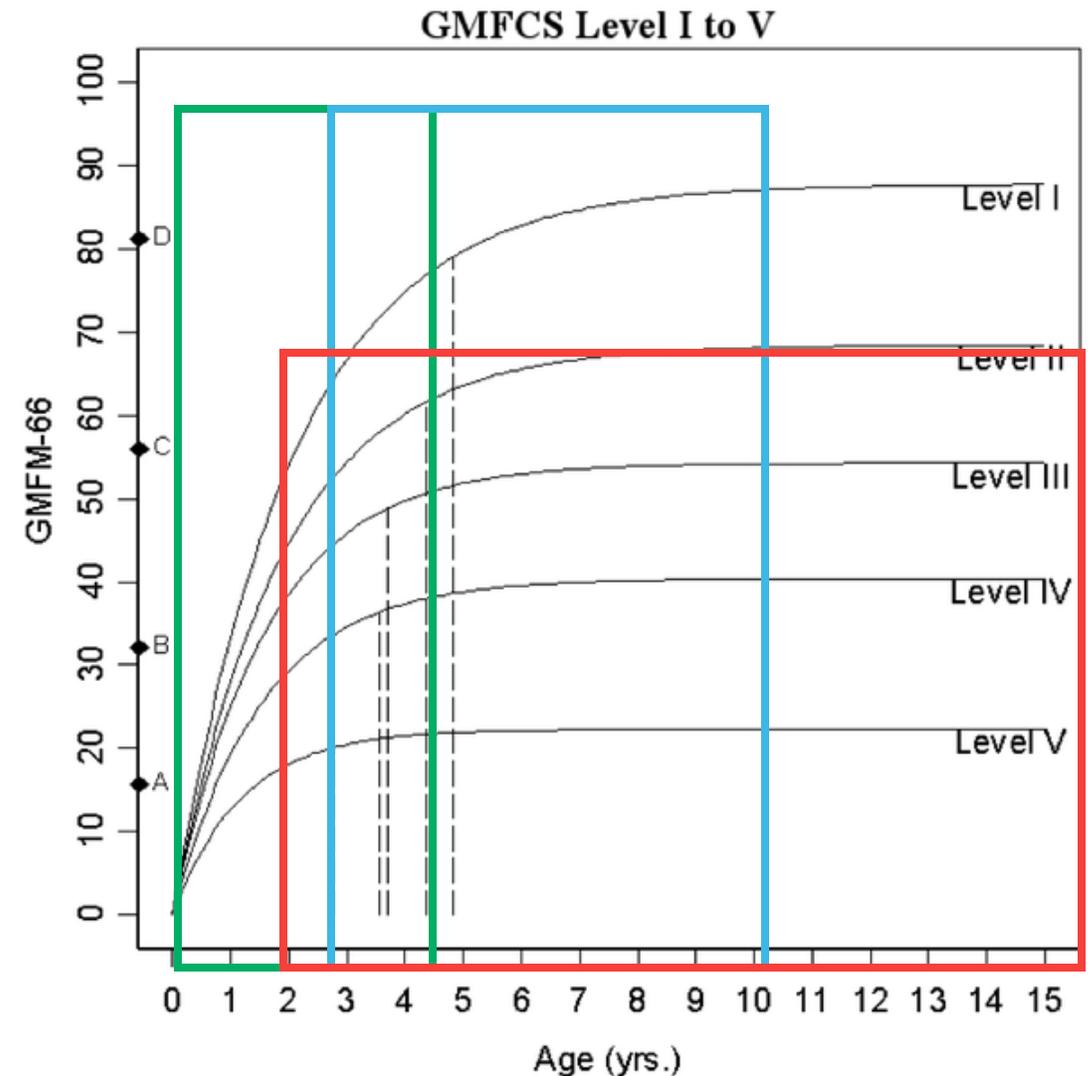
GMFCS in relation to GMFM

- Indicates average performance
- 90% of their motor development potential
- Indicates that early intervention is important

CHILD ACTIVE

COMPENSATE

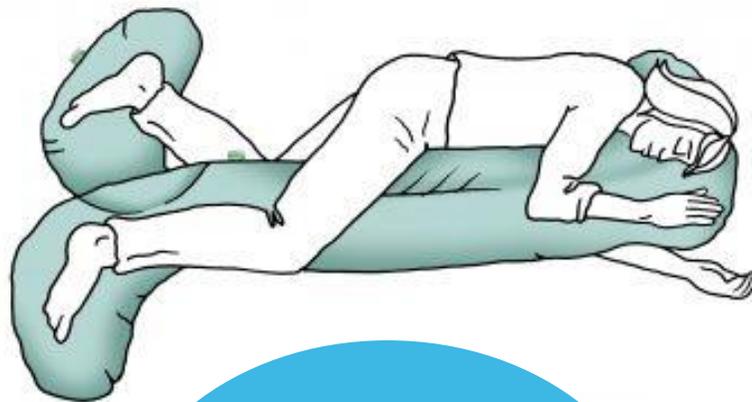
STOP NATURAL HISTORY (prevention)



Assistive technology

“Any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain or improve the functional capabilities of individuals with disabilities”

The Technology-Related Assistance for Individuals with Disabilities Act., 1988



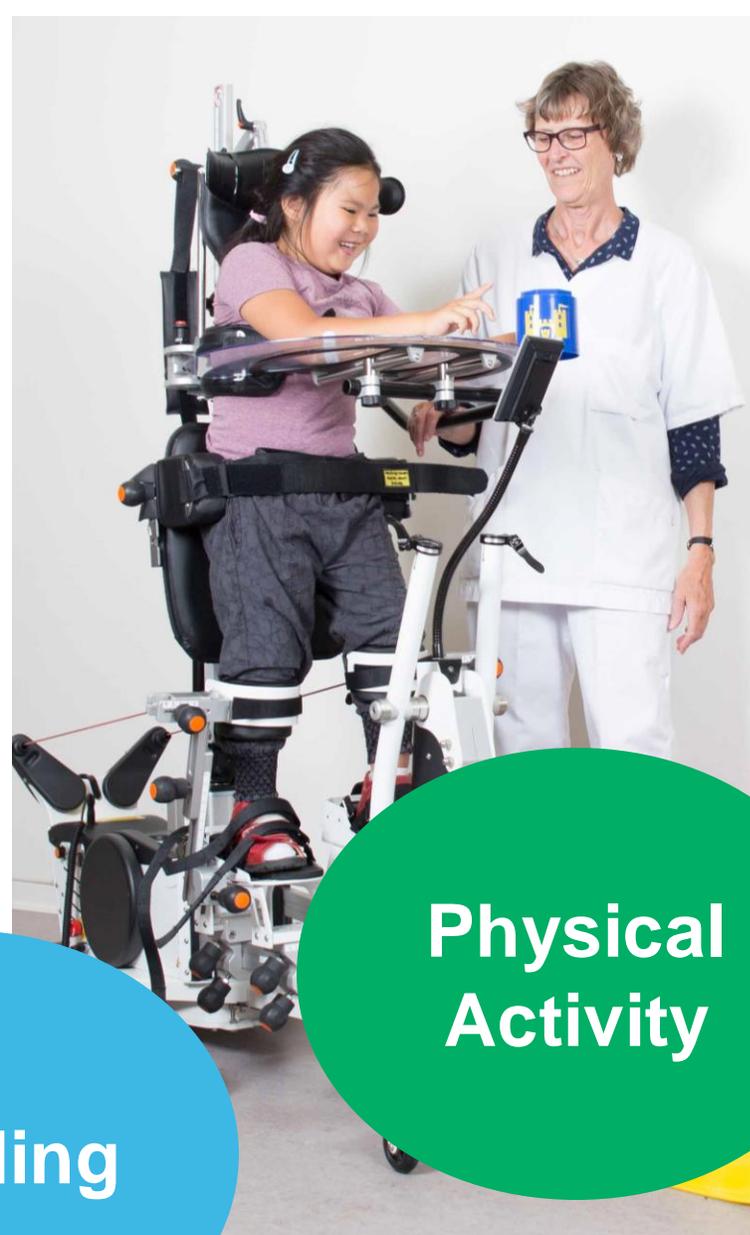
Lying

Sitting

24
hours

Standing

Physical
Activity



Assistive technology (AT)

Accommodate the child's disability to promote participation, independency, activity and prevent secondary complications.

When to start!

Children GMFCS II and III

- Postural support from early age

Children GMFCS IV and V

- Positioning in lying as early as possible after birth
- Sitting position around 6 month
- Standing position around 12 month

(Pope PM, 2014; Hadders-Algra, 2014)



AT to support walking/mobility



Promote

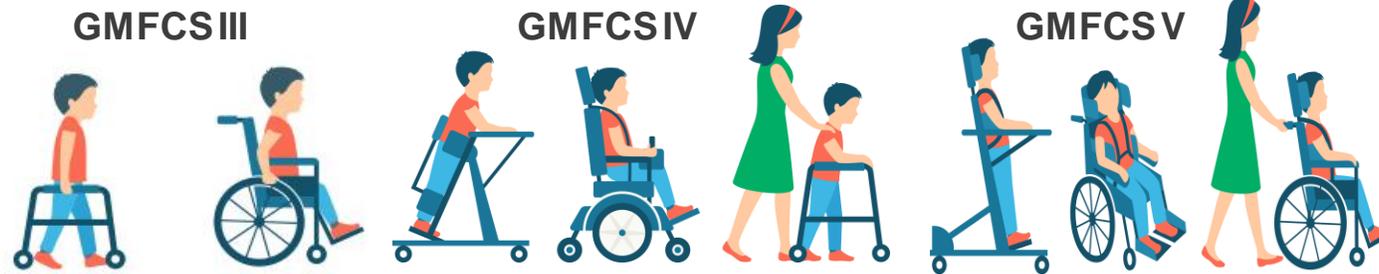
- Independency
- Participation
- Activity
- Mobility

Choice of device depending on

- Support needed
- Cognitive level
- Environment



AT to support standing



Promote

- Participation
- Activity

Prevent

- Secondary complications

Choice of device depending on

- Support needed
- Cognitive level
- Environment



Standing recommendations

- Bone mineral density
- ROM
- Gastrointestinal function
- Respiration and circulation
- Spasticity
- Muscle strength
- Mental function
- Physical activity



Paleg GS, Smith BA, Glickman LB; 2013. Pediatr Phys Ther 2013;25(3):232-47

Verschuren O, Peterson MD, Baleman AC, Hurvitz EA. Dev Med Child Neurol. 2016 Aug;58(8):798-808

Bone mineral density

Recommendations - 60-90 min/d 5x per week

People with disabilities are at **higher risk developing osteoporosis** due to lower level of motor function, inactivity, spasticity, nutrition.

«Children who are not standing are at risk for low BMD; therefore, standing may be an appropriate intervention to increase BMD. A dosage from 4-5 hours to 7.5 hours per week was need to maintain/increase BMD» (Paleg, Smith and Glickman, 2013)



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Range of motion

Recommendation - 45-60 min/d 5x per week

It is known that range of motion is strongly influenced by muscle tone. Muscle tone in children with CP is increasing up to 4 years of age and then reduced towards 12 years of age.

Adequate ROM is important to **prevent deformities** to achieve optimal function and quality of life (Hägglund, 2008)

«Standing programs can be safely started as early as 9-10 months of age. Clinical recommendations from the evidence is to stand at least 45-60 min/daily to increase hip, knee and ankle ROM» (Paleg, Smith and Glickman, 2013)

Green indicates what we regard as a normal or almost normal value.
Amber value should prompt a review of the child's management strategy.
Red value may require referral to orthopaedic department for assessment.

GMFCS I – III	RED	AMBER	GREEN
Hip abduction/knee ext	<30°	30° - 40°	>40°
Popliteal angle	>50°	40° - 50°	<40°
Knee extension	<0°		180° /0°
Dorsiflexion with flexed knee	<10°	10° - 20°	>20°
Dorsiflexion with extended knee	0<°	0° - 10°	>10°
Hip internal rotation	<30°	30° - 40°	>40°
Hip external rotation	3<0°	30° - 40°	>40°
Duncan Ely test	<100°	100° -120°	>120°
Hip extension	<10°		>10°

GMFCS IV – V	RED	AMBER	GREEN
Hip abduction	<20°	20° - 30°	>30°
Popliteal angle	>60°	40° - 60°	<40°
Knee extension	>10° fixed flexion	0°/10 fixed flexion	180° /0°
Dorsiflexion with flexed knee	<0°	0° - 10°	>10°
Dorsiflexion with extended knee	<-10°	-10° - 0°	>0°
Hip internal rotation	<30°	30° - 40°	>40°
Hip external rotation	<30°	30° - 40°	>40°
Ely test	<90°	90° - 110°	>110°
Hip extension	<-10°	-10° - 0°	>0°

Alarm value for children with CP (normal value - control/action - pathological)

Standing recommendations

- Bone mineral density
- ROM
- **Gastrointestinal function**
- Respiration and circulation
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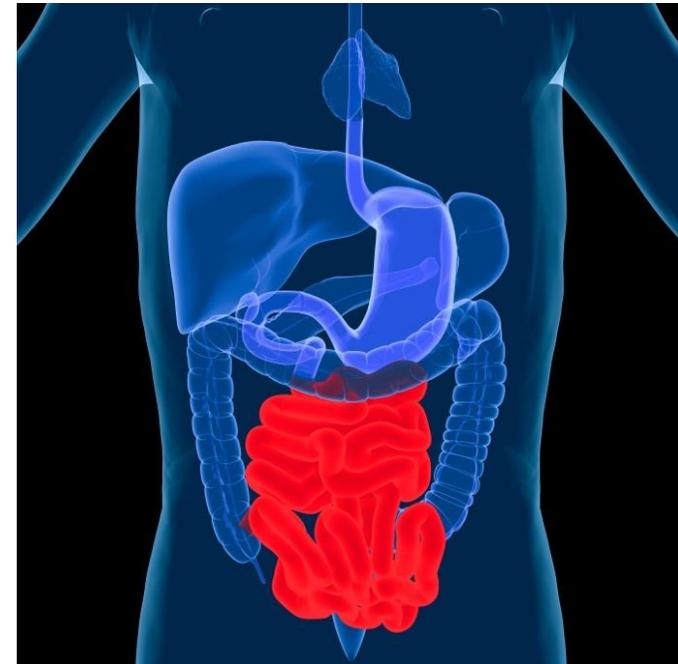
Gastrointestinal function

Recommendations – not clear

Gastrointestinal function is often affected in people with disabilities. The cause can be:

- ✓ Structural abnormalities
- ✓ Spasticity
- ✓ Inactivity
- ✓ Respiration problems
- ✓ Etc.

No clear recommendations, but daily standing for 30-60 minutes might influence bowel function



Standing recommendations

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Respiration and circulation

Recommendations – 30-60 min/daily - AKTIV STANDING

“During Dynamic versus Static standing, there is a statistical differences in metabolic exercise effects, oxygen consumption, carbon dioxide production, ventilation. Additionally the temperature at the feet maintained or increased”.
(Lauruschkus & Tornberg, 2018)



Standing recommendations

- Bone mineral density
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- **Spasticity**
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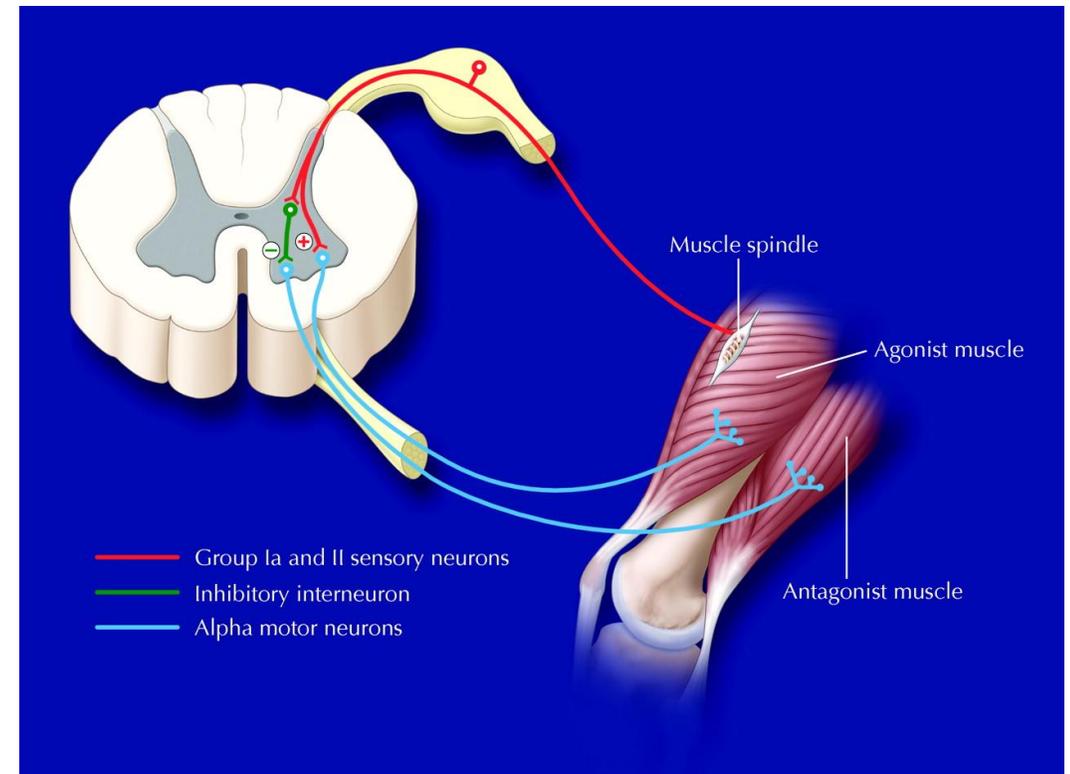
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Spasticity

Recommendations – 30-45 min/day

«Stand for 30-45 min/day to decrease spasticity. The effect on spasticity may last only for 35 min; therefore, follow standing with an activity that may improve with this short duration of decreased spasticity» (*Paleg, Smith and Glickman, 2013*)



Standing recommendations

- Bone mineral density
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- Mental function
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Muscle strength

Recommendations – ? – ACTIVE STANDING

«Standing in a device that allows for lower extremity movement may improve muscle strength»
(Paleg, Smith & Glickman, 2013)



Standing recommendations

- Bone mineral density
- ROM
- Gastrointestinal function
- Respiration and circulation
- Spasticity
- Muscle strength
- **Mental function**
- Physical activity



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Mental function

Recommendations – 30 min/d

A minimum of 30 min. of standing per day may be associated with an alert state and possible improve academic performance. Standing with movement, might have greater impact on alertness.

Paleg, Smith, Glickman (2013)

30-50% of children with CP have some level of cognitive impairments



Standing recommendations

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Physical activity

People with CEREBRAL PALSY

Spend **76%-99%** of their waking hours being sedentary

Fewer than **18%** are engaged in light physical activities

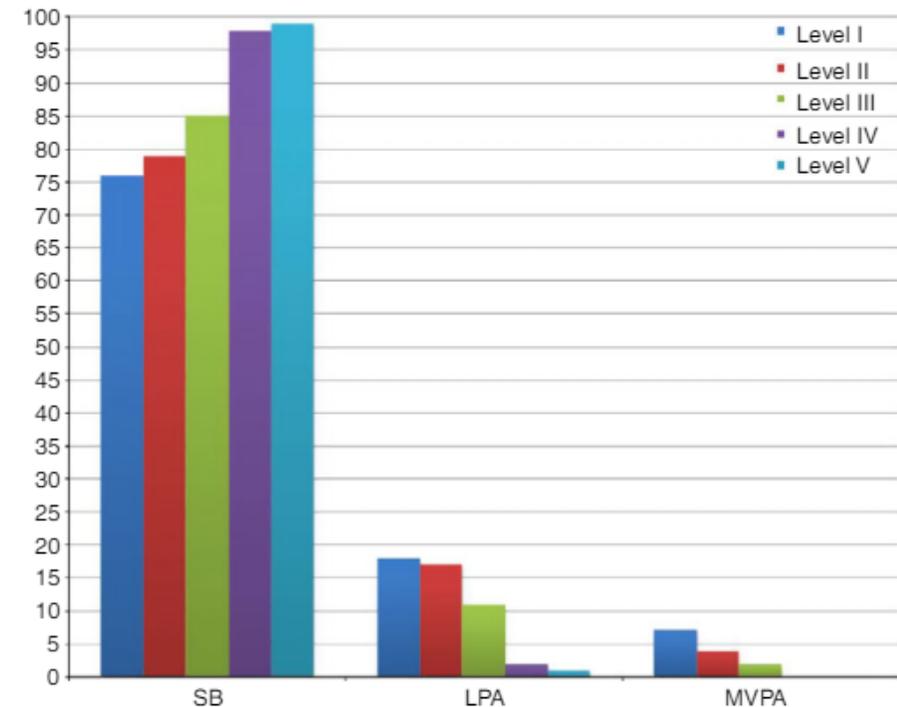
2%-7% in moderate to vigorous activities (GMFCS I-III)

Verschuren, 2016

Exercise and physical activity recommendations for people with cerebral palsy

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Physical activity recommendations

For people with cerebral palsy

- ✓ 5 days/week 60 min. moderate to vigorous PA
- ✓ 7 days/week < 2 hours leisure sitting-time
- ✓ 7 days/week break up sitting every 30-60 minutes
- ✓ Evidence support that **light-intensity physical activities are healthier than sedentary activities**
- ✓ Evidence suggests **that frequently interrupting sedentary time may have beneficial effects** on metabolic health and haemostasis

Verschuren, 2016



Standing

yes

It is recommended to stand

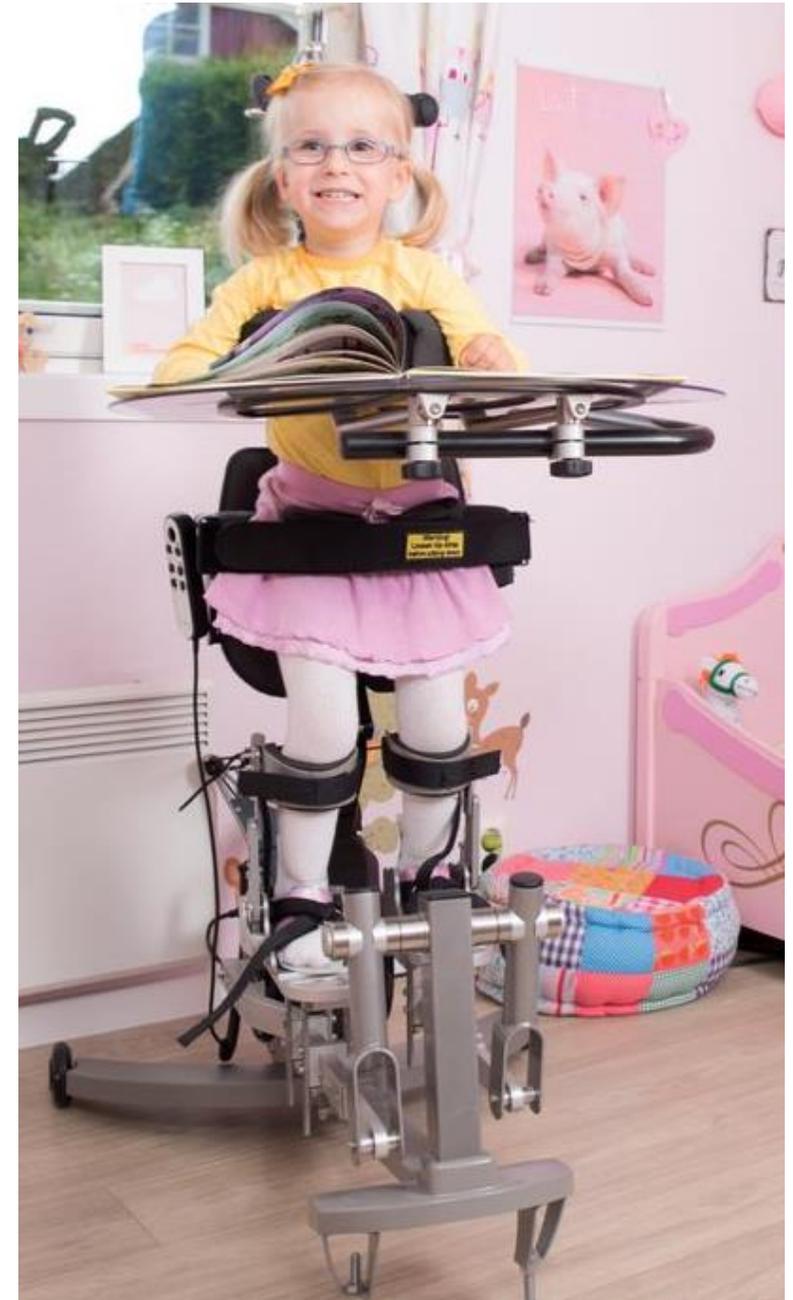
- Start early!
- Stand often! Minimum 5 times per week
- Total standing time can be accumulated during the day

Static versus Dynamic standing

New technology give new opportunities

Dynamic standing device for home use

- Dynamic standing
- Assisted, guided and repetitive movements
- Upright, weightbearing position
- Safe and comfortable movements
- Custom fitted



Evidence based research

RESEARCH ARTICLE

PeerJ

Participation in physical activity in children with cerebral palsy: effectiveness of physical activity prescription

Katarina Lauruschkus^{1*}, Inger Hallström

Abstract

Background: Children with cerebral palsy (CP) which implies risk factors for their physical activity intervention to promote a lifestyle change lacking about the use of physical activity prescription (PAP) for children with CP and its effectiveness.

Methods: Eleven children with CP, aged 8-10 years, their parents and the physical activity performance measure (COPM) and Goal Performance Measure (GPM-66), physical activity questionnaires were assessed at baseline, at 8 months and 16 months the feasibility of the intervention was evaluated by questionnaires.

Results: The intervention PAP consisted of self-selected physical activities during 3-5 minutes from baseline of COPM and GAS scores less than 30 and more than 240 minutes per week at 8 months.

Conclusions: The intervention PAP consisted of self-selected physical activities during 3-5 minutes from baseline of COPM and GAS scores less than 30 and more than 240 minutes per week at 8 months.

Trial Registration: ISRCTN76366356, registered 12/2018. Children, Cerebral palsy, Physical activity, Prescription

Submitted 7 December 2018
 Accepted 8 May 2019
 Published 18 June 2019
 Corresponding author: Katarina Lauruschkus, katarina.lauruschkus@med.lu.se
 Academic editor: Tjeerd Boonstra
 Additional Information and Declarations can be found on page 22
 DOI 10.7717/peerj.7098
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OPEN ACCESS

Effect of assisted static compared to dynamic non-ambulatory children with cerebral palsy: an international case study

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Static compared to dynamic non-ambulatory children with cerebral palsy: an international case study

Katarina Lauruschkus¹
 Department of Health Sciences, Lund University, Sweden



Figure 1. Static standing (SS) in a standing frame.

CONCLUSIONS

- The study of static standing (SS) in a standing frame is a promising method to improve physical activity in non-ambulatory children with cerebral palsy.
- Static and dynamic standing (DS) showed similar energy consumption and heart rate response.
- Dynamic walking (DW) was the most energy-consuming and heart rate-elevating activity.

INTRODUCTION

Non-ambulatory children with cerebral palsy (CP) are little physically active and have much sedentary time which implies significant health risks. The standard care in Sweden includes static standing training (SS) in standing frames for 45-90 minutes daily.

Dynamic standing training (DS): The motorised medical device Innowalk gives non-ambulatory children an opportunity to experience walking movement in an upright weight-bearing position. More knowledge about SS compared to DS is needed in order to give the best recommendations.

RESULTS

- The measurements could be performed in this setting.
- Both SS and DS can be considered to be physical activity since the energy consumption was above 1.5 METs.
- During DS in the Innowalk deeper breathing was observed (Figure 3).
- The children were able to maintain and even increase temperature at their feet (Temperature @30 min during DS).

Habilitation and Assistive Technology
 Skane Region, Sweden



Effects on the Passivity after Dynamic Standing in Children with Cerebral Palsy

Lauruschkus K, RPT, PhD & Tornberg ÅB
 Department of Health Sciences, Lund University, Lund, Sweden



Dynamic standing in the motorized device Innowalk

CONCLUSIONS

- 30 minutes of dynamic standing in the Innowalk was sufficient to improve physical activity in non-ambulatory children with cerebral palsy.
- 30 minutes of dynamic standing in the Innowalk was sufficient to improve physical activity in non-ambulatory children with cerebral palsy.

ARTICLE INFO

Keywords: Cerebral palsy, Robotic rehabilitation, Walking

INTRODUCTION

The recommendations for non-ambulatory children with cerebral palsy (CP) include static standing for 45-90 minutes daily. The motorised medical device Innowalk offers an opportunity to experience walking in an upright weight-bearing position, making it a promising method to improve physical activity in non-ambulatory children with cerebral palsy.

The aims were to describe the effects of dynamic standing, and to compare the effects of static and dynamic standing in the Innowalk.

Full length article

Effects of robotic rehabilitation on walking in hemiparetic cerebral palsy

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⁴ Hasan Kalyoncu University Faculty of Health Sciences, Department of Physiotherapy, Gaziantep, Turkey



ABSTRACT

Background: The most common functional asymmetry in walking is hemiparesis. Robotic rehabilitation devices represent a promising method to improve physical activity in non-ambulatory children with cerebral palsy.

Research Question 1: Can walking be improved with the use of a robotic device?

Research Question 2: The walking and locomotion performance of children with hemiparesis after treatment with a robotic device.

Methods: This prospective study included 10 children with hemiparesis who were included in an intervention program. After treatment, after three months, walking and locomotion performance were assessed. The mean age of the children was 10.5 years. The mean duration of CP was 7.5 years. The mean severity of CP was 3.5. The mean duration of CP was 7.5 years. The mean severity of CP was 3.5.

Significance: RGT, balance, walking speed, performance. RGT can be used to assess the effects of robotic rehabilitation on walking in hemiparetic cerebral palsy.

Introduction

The recommendations for non-ambulatory children with cerebral palsy include static standing in standing frames for 45-90 minutes daily. Earlier studies have shown extremely low physical activity in this group. The aim was to compare the metabolic adaptive effects of static standing versus dynamic standing in the motorised medical device Innowalk, on cardiopulmonary and metabolic parameters.

Patients and methods

Eighteen non-ambulatory children with cerebral palsy participated in an exercise intervention study with a crossover design, comparing four months of static standing to four months of dynamic standing.

Differences in Exercise Effects from Static and Dynamic Standing in Non-Ambulatory Children with Cerebral Palsy

Tornberg Å.B¹, Associate Professor, RPT; Hansson V², MSc; Jakobsson A², Professor & Lecturer

Conclusion

- A highly statistically significant difference was found in the metabolic adaptation, described as oxygen consumption, carbon dioxide production, and ventilation, to static standing versus dynamic standing.
- Static standing and dynamic standing represents different exercise modalities.
- Dynamic standing through robotic walking offers new possibilities to design different exercise regimes to non-ambulatory children with cerebral palsy.

Adaptive effects from the exercise programs through indirect calorimetry were assessed during 30 minutes of static standing and dynamic standing. An airtight mask covering mouth and nose was worn in order to measure breath-by-breath oxygen consumption, carbon dioxide production, and ventilation. Heart rate was recorded continuously throughout the test.

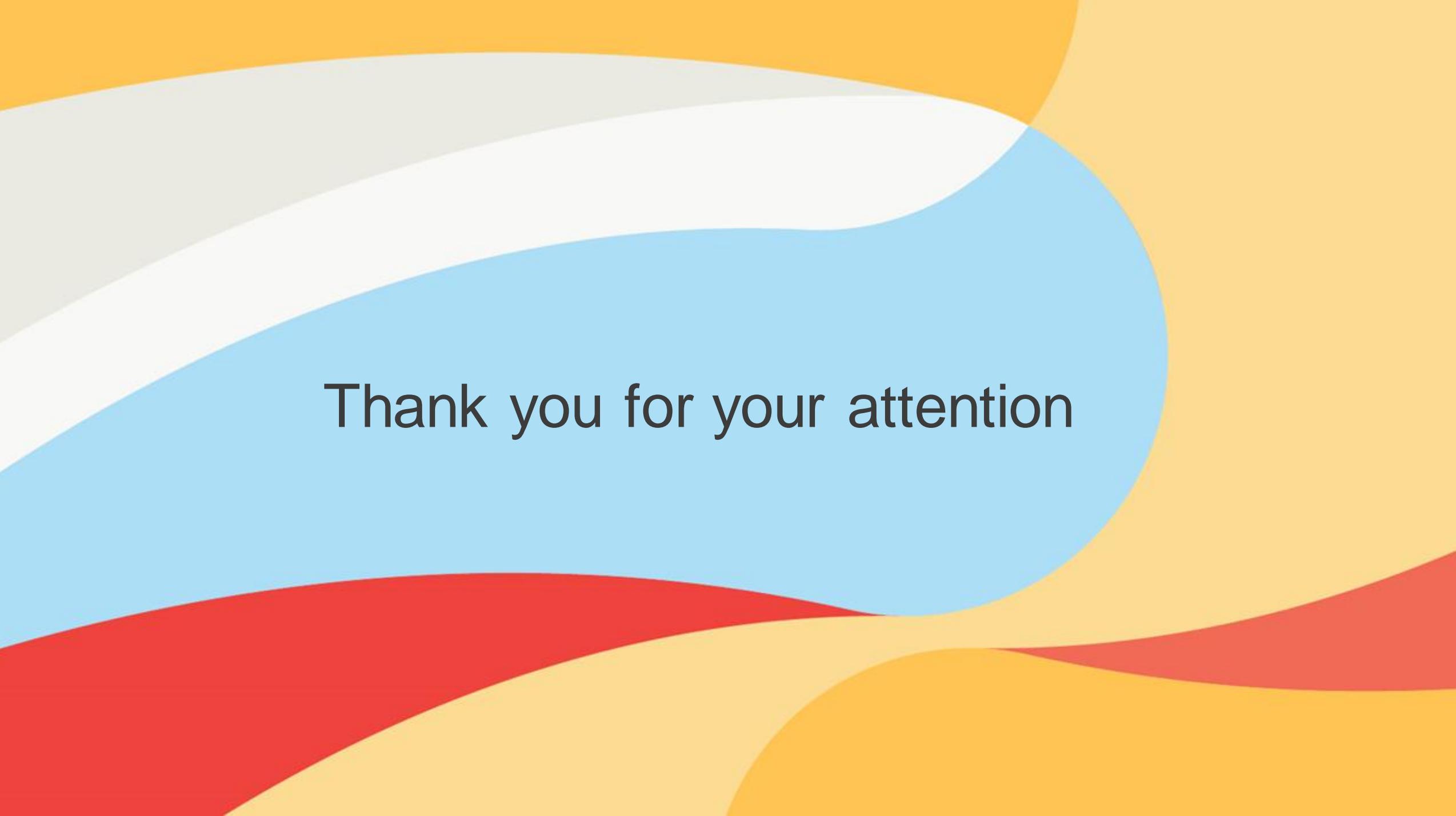
As many of the variables were linearly correlated, robust Principal Component Analysis (rPCA) was used to determine the components carrying most information. A multidimensional Shapiro-Wilk test indicated that the data can be well described as multivariate normal distributed, allowing for the use of multivariate statistical methods.



Dynamic standing

- **Physical activity** (PA) above 1.5 MET (2.2 ± 1.3) – Light PA
- During Dynamic versus Static standing, there is a statistical differences in **metabolic exercise effects, oxygen consumption, carbon dioxide production, ventilation**
- **Deeper respiration** during dynamic standing compared to static standing
- 30 min of dynamic standing **increases passive range of motion** (PROM) and **lower the spasticity** in the muscles around the joint in the lower extremities
- **Temperature** of the feet maintains or increases during dynamic standing
- A meta-analysis including 31 participants using dynamic standing, showed **clinical improvements** for 94%
- CP children GMFCS II-III **improved “Time-up-and-go”, 10-meter walk test, 6-minute walk test** after using the dynamic standing compared to treadmill training
- Robotic gait training can provide a **faster and higher effect** on the development of functional muscle strength, balance, walking speed and endurance than the standard physiotherapy rehabilitation program in CP children with GMFCS I-II

Assistive technology to increase or maintain functional capabilities of individual with disabilities

The background features several overlapping, wavy bands of color. From top to bottom, the colors are yellow, white, light blue, and red. The bands are smooth and fluid, creating a modern, abstract aesthetic. The text is centered within the light blue band.

Thank you for your attention