Supportive Footwear Improves Gait Speed and Gait Pattern in Adults with Down Syndrome

Bailey Gosse1, PT, DPT, Kimberly Nguyen1, PT, DPT, Zoe Zelensky1, PT, DPT, Sarah Mann2, PT, DPT, Kai-Yu Ho1, PT, DPT, PhD, Thessa Hilgenkamp1, PhD
1 Department of Physical Therapy, University of Nevada, Las Vegas, Las Vegas USA 2 Mann Method PT and Fitness, Arvada, Colorado 80005, USA

Introduction

Individuals with Down syndrome (DS) often experience a slower gait speed and decreased quality of gait. Individuals with DS often have gait impairments that include: forward tilted pelvis, increased hip flexion throughout the gait cycle, increased hip stiffness, knee flexion that is reduced in swing phase, increased knee flexion in stance phase, reduced ankle power, and reduced ankle joint stiffness. Different types of footwear have shown changes in gait in people without DS.

Aims

We aimed to examine the differences between wearing commercially available supportive shoes, wearing unsupportive shoes, and walking barefoot on gait quality and speed in people with DS.

Methods

- Participants (DS n=20) completed the **10-meter walking test** walking barefoot, wearing unsupportive footwear, and wearing supportive footwear – all trial recorded on video from frontal and sagittal view
  - Repeated measures design with randomized footwear conditions
- Supportive shoe = Saucony Triumph

Supportive shoe

Lightweight, flexible sneaker with a neutral fit, wide toe box, medial arch support, and calcaneal support

- Unsupportive shoe = Crocs Classic Clog

Unsupportive shoe

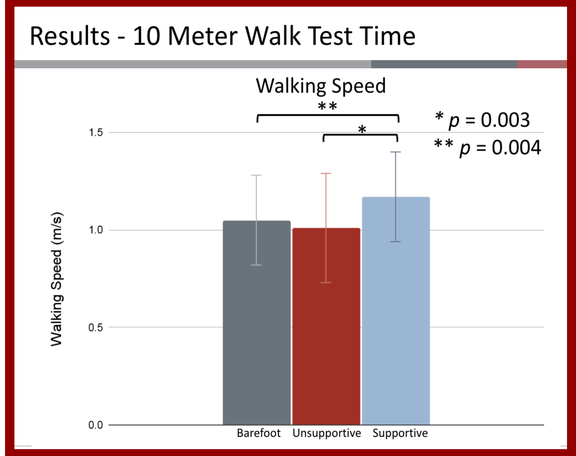
Decreased foot support and recommended as the unsupported shoe by a clinician who specializes with DS observed its widespread use and popularity among individuals with DS

- Outcome Measures
  - Foot Posture Index (FPI)

Highly Supinated	Supinated	Normal	Pronated	Highly Pronated
-5 to -12	-1 to -4	0 to +5	+6 to +9	+10 to +12

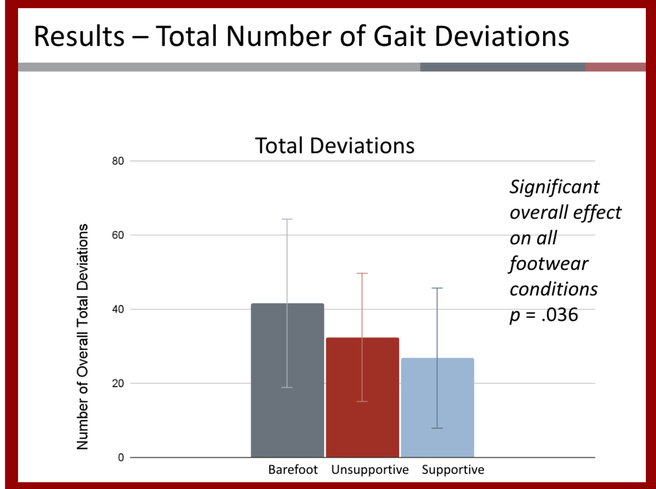
  - Gait Speed (m/s)
  - Rancho Los Amigos Gait Assessment – Observational Gait Assessment (OGA)
    - Total Deviations (Major + Minor in all Body Regions)
    - Major Deviations/Minor Deviations
    - By Body Region
    - By Phase of Gait Cycle
- Statistics:
  - Repeated measures ANOVA
  - Bonferroni method for post-hoc pairwise comparisons
  - FPI-6: continuous covariate (if warranted)

Adults with DS who wore supportive shoes had the fastest gait speed



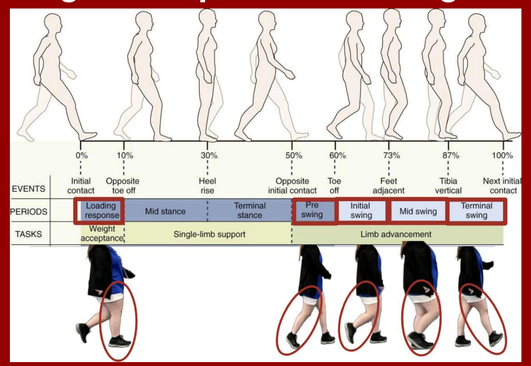
Gait Speed		
Barefoot	Crocs	Sauconys
8.5s	9.1s	7.2s

Adults with DS who wore supportive shoes demonstrated better gait quality with fewer deviations compared to when they walked barefoot



Total Gait Deviations		
Barefoot	Crocs	Sauconys
48	36	24

Adults with DS who wore shoes demonstrated decreased gait deviations during weight acceptance and single limb advancement



Results

- Individuals in the study had an average FPI of +7 (pronated)
  - All participants had normal to highly pronated feet
  - FPI score was not significantly correlated with walking speed or gait deviations ($p > 0.05$)
- Gait Speed was fastest when wearing supportive shoes.
- Total and major gait deviations - significantly different between gait conditions in favor of the supportive shoes
- Body Region – with supportive shoes, decreased gait deviations across conditions at the pelvis, ankle, and foot

Outcome	Type deviation	Barefoot	Crocs	Saucony	Repeated measures ANOVA
Trunk	Total	1.3 (3.5)	0.3 (1.0)	1.1 (3.3)	0.482
Pelvis	Total	4.7 (7.0)	9.2 (9.3)	5.6 (7.9)	0.049
Hip	Total	7.1 (7.6)	9.1 (9.3)	7.9 (6.0)	0.643
Knee	Total	5.3 (5.8)	3.6 (3.1)	3.4 (3.6)	0.213
Ankle	Total	17.2 (8.7)	10.2 (7.4)	8.9 (8.2)	0.011
Foot	Total	6.1 (2.7)	0 (0)	0 (0)	0.001*

- By phase of gait cycle – decreased gait deviations during weight acceptance and single limb advancement – across conditions

Outcome	Type deviation	Barefoot	Crocs	Saucony	Repeated measures ANOVA
Weight Acceptance	Total	9.6 (5.0)	7.5 (2.9)	6.2 (4.3)	0.015*
	Major	6.5 (3.3)	4.8 (2.6)	4.0 (3.1)	0.010*
	Minor	3.2 (2.6)	2.9 (2.3)	2.3 (2.3)	0.438
Single Limb Stance	Total	11.2 (7.2)	10.4 (6.3)	8.6 (7.5)	0.438
	Major	8.3 (5.3)	6.5 (4.2)	5.5 (5.0)	0.215
	Minor	2.9 (3.1)	4.0 (3.0)	3.0 (3.2)	0.374
Single Limb Advancement	Total	20.7 (12.3)	14.2 (11.0)	11.9 (8.8)	0.022*
	Major	5.7 (4.3)	2.9 (3.3)	3.3 (3.3)	0.056
	Minor	15.1 (9.9)	11.3 (9.5)	8.5 (7.7)	0.028*

Discussion and Conclusion

- Supportive shoes improved **gait speed** compared to both unsupportive shoes and barefoot.
- Supportive shoes **improved gait quality** compared to walking barefoot.
- Supportive shoes **decreased gait deviations** compared to unsupportive shoes in some but not all outcomes.
- Providers should recommend shoes with good medial arch support and calcaneal support due to the typically **pronated feet** of individuals with DS
  - Clinicians can recommend **Saucony Triumphs** as they allow for a neutral fit and wide toe box to accommodate the foot of a person with DS – they are available commercially
- Providers should promote the use of supportive footwear during gait speed or **document type of footwear**

Decreased gait speed is a predictor of decreased mobility and ability to perform activities of daily living in adults with intellectual disabilities. Gait deviations may have potential for long-term effects on musculoskeletal impairments, functional activity limitations, and participation in daily activities. Based on our results, the use of supportive shoes is recommended for adults with DS.