CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

In a middle school aged child (11 y.o.) with quadriplegic spastic cerebral palsy who uses a posterior walker to independently navigate the school environment, is treadmill training or overground training a more effective intervention when considering the limited time he has with school physical therapist for improving independent gait as indicated via ambulation testing (6 minute walk test, 10 meter walk test)?

AUTHOR

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CLINICAL SCENARIO

The patient is an 11 year old boy in a public middle school with a diagnosis of quadriplegic spastic cerebral pasly who is being seen in the school setting by the school PT. The child uses a posterior walker throughout the school day and to navigate within the home, however he has been working with the therapist on taking a few short steps without support, to get from his desk to where his walker is for example. Without the support of his walker, the wall, or the therapist the child is extremely unsteady and has poor balance, frequently requiring mod/max assistance after a loss of balance when attempting to walk the school hallways without his walker. Typically the child does not experience losses of balance, but is unable to keep up with his peers, has forward posture with rounded shoulders, and requires frequent breaks to navigate the school. The PT typically starts their sessions with 10-15 minutes on a treadmill with no body weight support and the child using the treadmills lateral arm supports, however some sessions overground training throughout the school is used. The district does have access to a rifton pacer gait trainer with a treadmill base, but does not currently have the ability to bring it to this particular child's school. I would like to determine the best method of performing gait training with this child to optimize our therapy time as well as his potential for functional gains in areas such as functional mobility, endurance, balance, and speed.

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

Eight studies met the exclusion criteria including 1 meta-analysis, 5 randomized control trials, and 2 cross-sectional comparative studies.

- Unsupported treadmill training protocols lead to greater changes in functional mobility, gross motor function, functional performance and functional balance when compared to a similar overground training protocol, however both groups experienced significant improvements.[2]
- Partial Body weight supported treadmill training was equally as effective at improving endurance, gait speed, and gross motor function when compared to overground training.[6,7]
- Significant improvement in gait characteristics may be observed after just 4 weeks of overground or supported treadmill training, however further improvements can be gained with prolonged interventions up to 8 weeks.[6]
- Treadmill training and overground training, when provided in appropriate frequency and duration (2x/week for 30 minutes each session, 4 - 8 weeks) as well as intensity (encouraging fastest safe self-paced walking speed, or utilizing a treadmill testing protocol 2)[2,6,7]

CLINICAL BOTTOM LINE

Children with mild to moderate disability as a result of cerebral palsy (GMFCS I-III) in need of gait training should participate in regular gait training for a minimum of 4 weeks, but up to 8 weeks and beyond to see continued improvements in functional performance, mobility, balance, gross motor skills, gait speed, and cardiovascular responses to ambulation. Greatest functional changes have been observed in those children participating in unsupported treadmill training at a % tolerance based on maximal tolerance testing, however improvements in gait characteristics are seen across interventions to include overground training and body weight supported treadmill training as well.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
“cerebral palsy” “cp” “spastic quadriplegia” “spastic quadriplegic cerebral palsy” “spastic cerebral palsy”	Treadmill Training (treadmill training, body weight supported treadmill training)	Overground Training (overground ambulation, overground walking)	6 minute walk test 10 meter walk test

Final search strategy (history):

PubMed

- cerebral palsy OR cp OR spastic quadriplegia OR spastic quadriplegic cerebral palsy OR spastic cerebral palsy
    a. cerebral palsy: "cerebral palsy"[MeSH Terms] OR ("cerebral"[All Fields] AND "palsy"[All Fields]) OR "cerebral palsy"[All Fields]
    b. cp: "Cogn Process"[Journal:__jid101177984] OR "cp"[All Fields]
    c. spastic quadriplegia: "quadriplegia"[MeSH Terms] OR "quadriplegia"[All Fields] OR ("spastic"[All Fields] AND "quadriplegia"[All Fields]) OR "spastic quadriplegia"[All Fields]
    d. spastic: "muscle spasticity"[MeSH Terms] OR ("muscle"[All Fields] AND "spasticity"[All Fields]) OR "muscle spasticity"[All Fields] OR "spastic"[All Fields] OR "spasticity"[All Fields] OR "spastics"[All Fields] OR "spasticities"[All Fields]
    e. quadriplegic: "quadriplegic"[All Fields] OR "quadriplegics"[All Fields]
    f. cerebral palsy: "cerebral palsy"[MeSH Terms] OR ("cerebral"[All Fields] AND "palsy"[All Fields]) OR "cerebral palsy"[All Fields]
    g. spastic cerebral palsy: "cerebral palsy"[MeSH Terms] OR ("cerebral"[All Fields] AND "palsy"[All Fields]) OR "cerebral palsy"[All Fields] OR ("spastic"[All Fields] AND "cerebral"[All Fields] AND "palsy"[All Fields]) OR "spastic cerebral palsy"[All Fields]
- treadmill*
- overground*
- **#1 AND #2 AND #3**
  ("cerebral palsy"[MeSH Terms] OR ("cerebral"[All Fields] AND "palsy"[All Fields]) OR "cerebral palsy"[All Fields] OR ("cogn process"[Journal] OR "cp"[All Fields]) OR ("quadriplegia"[MeSH Terms] OR "quadriplegia"[All Fields] OR ("spastic"[All Fields] AND "quadriplegia"[All Fields]) OR "spastic quadriplegia"[All Fields]) OR (("muscle spasticity"[MeSH Terms] OR ("muscle"[All Fields] AND "spasticity"[All Fields]) OR "muscle spasticity"[All Fields] OR "spastic"[All Fields] OR "spasticity"[All Fields] OR "spastics"[All Fields] OR "spasticities"[All Fields]) AND ("quadriplegic"[All Fields] OR "quadriplegics"[All Fields]) AND ("cerebral palsy"[MeSH Terms] OR ("cerebral"[All Fields] AND "palsy"[All Fields]) OR "cerebral palsy"[All Fields])) OR ("cerebral palsy"[MeSH Terms] OR ("cerebral"[All Fields] AND "palsy"[All Fields]) OR "cerebral palsy"[All Fields] OR ("spastic"[All Fields] AND "cerebral"[All Fields] AND "palsy"[All Fields]) OR "spastic cerebral palsy"[All Fields])) AND "treadmill*"[All Fields] AND "overground*"[All Fields] (8 results)

CINAHL

- cerebral palsy OR cp OR spastic quadriplegia OR spastic quadriplegic cerebral palsy OR spastic cerebral palsy
- treadmill
- overground
- Limiters - Published Date: 20050101-20201231
- **(cerebral palsy OR cp OR spastic quadriplegia OR spastic quadriplegic cerebral palsy OR spastic cerebral palsy) AND treadmill AND overground (22 results)**

Cochrane

- cerebral palsy OR cp OR spastic quadriplegia OR spastic quadriplegic cerebral palsy OR spastic cerebral palsy
- treadmill training OR body weight support treadmill training
- overground ambulation OR overground walking OR overground training
- with Cochrane Library publication date from Jan 2005 to Dec 2020
- **(cerebral palsy OR cp OR spastic quadriplegia OR spastic quadriplegic cerebral palsy OR spastic cerebral palsy):ti,ab,kw AND (treadmill training OR body weight support treadmill training):ti,ab,kw AND (overground ambulation OR overground walking OR overground training):ti,ab,kw (Word variations have been searched) (13 results)**

PEDro

- **Abstract & Title: cerebral palsy, treadmill training**
- **Published since: 2005**
- **(40 results)**

Databases and Sites Searched	Number of results	Limits applied, revised number of results (if applicable)
PubMed	**8**	**8 -** Limits: clinical trials, meta-analyses, systematic reviews, RCTs, published after 2005
CINAHL	**22**	**20 -** Limits: published after 2005, Academic journal
Cochrane	**13**	**13 -** Limits: published after 2005
PEDro	**40**	N/A

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
• Population: diagnosis of spastic cerebral palsy • Outcome: ROM measurements • RCTs, Quasi-experimental studies, Uncontrolled trials, Systematic Review, Meta-analyses, Quantitative or Mixed Method study • Published after 2005
Exclusion Criteria
• Not published in english • Not case studies, case series or narrative review articles • Not qualitative research • Not conference proceedings, poster presentations, dissertations

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
Willoughby (2010)	PEDro - 7/11	2a (poor follow up, <80%)	High	Single-Blind RCT
Grecco (2015)	PEDro - 8/11	1b	High	Single-Blind RCT

Swe (2015)	PEDro - 9/11	1b	High	Single-Blind RCT
Wu (2017)	PEDro - 7/11	1b	Low	RCT
Gillett (2019)	PEDro - 6/11	1b	Low	RCT
Han (2020)	AMSTAR - 7/11	1a	Moderate	Meta-Analysis
Matsuno (2010)	Downs & Black - 13/29	4	Low	Cross-sectional Comparative
Jung (2016)	Downs & Black - 14/29	4	Low	Cross-sectional Comparative

*Indicate tool name and score

**Use Portney & Watkins Table 16.1 (2009); if downgraded, indicate reason why

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- Grecco LA, Zanon N, Sampaio LM, Oliveira CS. A comparison of treadmill training and overground walking in ambulant children with cerebral palsy: randomized controlled clinical trial. Clin Rehabil. 2013 Aug;27(8):686-96. doi: 10.1177/0269215513476721. Epub 2013 Mar 15. PMID: 23503736.
  - Assesses the PICO question directly- is treadmill training or overground training more effective in improving gait parameters? In particular this study did not utilize any body weight support, which is most similar to the clinical case. Additionally, they used a comprehensive list of outcome measures common to pediatric practice in the school system, including those within my inclusion criteria, to more holistically assess impacts of treadmill versus overground training.
- Swe NN, Sendhilnnathan S, van Den Berg M, Barr C. Over ground walking and body weight supported walking improve mobility equally in cerebral palsy: a randomised controlled trial. Clin Rehabil. 2015 Nov;29(11):1108-16. doi: 10.1177/0269215514566249. Epub 2015 Jan 30. PMID: 25636992.
  - This study was performed within a school system and covered all aspects of my PICO question, including similar intervention/treatment times to what we may expect within the school system. This study was very similar to the Willoughby (2010) study, I choose this study over the Willoughby study due to the higher rates of follow up, baseline comparability between groups, and recency of the article.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of (A comparison of treadmill training and overground walking in ambulant children with cerebral palsy: randomized controlled clinical trial) by (Grecco et al., 2013)

Aim/Objective of the Study/Systematic Review:
The aim of this study by Grecco et al. was to determine whether treadmill and overground gait training lead to improvements in functional mobility, functional performance, gross motor function and balance in children with cerebral palsy who use ambulation as their primary source of mobility, not using body weight support for either of the intervention methods. Additionally, they sought to determine if there were significant differences in improvements made between the overground training group and the treadmill training group both after the intervention and at a month follow up to assess which may be more effective for clinical practice in children with cerebral palsy.
Study Design [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant] Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

This study was a prospective randomized control trial in which random allocation into control versus experimental groups was done at a central office in Sao Paulo, Brazil. To promote confidentiality randomization was done using numbered, sealed, and opaque envelopes which included to which group each child had been assigned. The same rater was used for measurement of all outcome measures throughout the study, and this blind rater did not know to which group each child had been assigned. 58 children were assessed for their appropriateness of participation in the study, of which 35 were randomly allocated into experimental and control groups.

Outcome measures were assessed at initial assessment of each child, again at the completion of the intervention (7 weeks) and again at a 1 month follow up (4 weeks after the intervention ended).

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

The study was performed in physical therapy clinics in Sao Paulo, Brazil. No other information was provided regarding the type of clinic, or where overground training was performed (ex. if indoors versus outside). São Paulo, Brazil is the 7th largest city in the world, and the most populous city in Brazil so we may assume the clinics were in a fairly urban metropolitan area.[1]

1. Minkel CW, Leite A. São Paulo. Encyclopaedia Britannica. https://www.britannica.com/place/Sao-Paulo-Brazil. Published October 30, 2020. Accessed November 27, 2020.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

Children included within the study were between the ages of 3 to 12 years old with an average of 6.8 years in the experimental group and 6.0 years in the control group. Upon initial assessment all participants fell within Levels I, II or III on the GMFCS with 5/8/3 in the experimental group and 8/7/2 in the control group (level I/II/III respectively). All participants used ambulation as their primary form of transport, and had been ambulating for function for a minimum of 1 year. Children who used assistive ambulatory devices and/or habitual braces were included within the study and allowed to use these devices/orthoses when appropriate. Any orthopedic surgical procedures, orthopedic deformities requiring surgery, or neuromuscular blocks (aka botulinum toxin) rendered a child ineligible for participation.

No information was provided on where participants were recruited from.

3 participants did not complete the final follow through of the study, 2 due to hospitalizations and a 3rd due to receiving botulinum toxin injections, making them ineligible to continue the study.

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

Interventions for both groups were provided by a physiotherapist, a different individual than the one performing the rating/scoring of outcome measures. The treatment was administered at physical therapy clinics in Sao Paulo, Brazil however no further information is provided on the clinic setting or where overground was performed. The control group (overground walking, gait training on a fixed surface) participated in 2 30 minute gait training sessions over the course of the 7 week intervention, with the first 2 sessions (week 1) considered familiarization with the speed and duration of the intervention. The children were able to wear their habitual braces as well as use assistive devices as needed. The clinician providing intervened and would assist with components of the gait cycle if they determined it was needed. Children were instructed to walk at a comfortable pace for the 1st and final 5 minutes of the 30 minute session, and the middle 20 minutes they were instructed to increase their speed. Gait speed was not monitored in the control group, however heart rate was monitored in both the experimental and control groups to ensure children did not overexert the cardiovascular system. No body weight support was provided for either of the intervention groups.

Experimental

The experimental intervention consisted of treadmill gait training, again 2 times/week for 30 minute sessions over the course of 7 weeks. Again, children were able to use their habitual braces, but were unable to use any assistive devices. In order to determine an appropriate walking speed an initial treadmill test was performed to determine a child's maximal tolerated speed and peak HR before eliciting predetermined criteria for the completion of the test. The authors of the study created this treadmill test protocol as there is no current standardized treadmill measure in pediatric populations. This 'symptom-limited cardiopulmonary effort test' is discussed below in 'Outcome Measures'. Using the results of this test the experimental group children were asked to walk at 60 - 80% of their maximal tolerance based on the test, using 60% of max for the first and final 5 minutes, and 80% of max for the middle 20 minutes of the session.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

Outcome measures were taken at initial assessment, once the intervention was completed at 7 weeks, and again at a 1 month follow up after the intervention concluded (4 weeks later). All outcomes were measured by the same blind rater, different from the therapist responsible for administering the interventions. All participants took part in all of the outcome measures regardless of whether they were assigned to the treadmill or overground training groups, which were performed at the physical therapy clinics.

Functional Mobility Tests:

- 6-minute walk: a measurement of distance covered over the course of 6 minutes. The examiner measured heart rate, respiratory rate, oxygen saturation, systolic and diastolic blood pressure, perceived respiratory and lower limb exertion (Borg scale). Assistive devices and braces/orthoses are typically allowed during the 6mwt. The 6mwt was considered the primary outcome of the study used for comparison from baseline to follow up, as well as between groups.
- Timed up-and-go: participants are asked to stand from a chair without arm supports, walk 3 meters, turn around, and return back to the chair and sit back down, all of which is measured in seconds and allows a participant to use their orthoses/braces and assistive devices.

Functional Performance Test:

- Pediatric Evaluation Disability Inventory (PEDI)[1]: the PEDI is a quantitative measure with 3 parts, only part I (Functional Skills) was utilized for this study. The functional skills part of the PEDI utilizes 3 functional categories for assessment of a child's skills: self care (73), mobility (59), and social function(65). One point is awarded for each of the tasks and the 3 categories are totalled for a final score of up to 197.

Gross Motor Function Test:

- Gross Motor Function Measure-88 (GMFM): the GMFM includes 88 items which are broken down into 5 categories: A) lying down and rolling, B) sitting, C) crawling and kneeling, D) standing, and E) walking, running and jumping. Each of the 88 items can receive a score of 0-3 points, with a maximum score of up to 264, which may also be presented as a % based on each category or the total score.

Balance:

- Functional - Berg Balance Scale: the BBS consists of 14 items, each of which assesses various aspects of functional balance. Each item is scored on a 0-4 point scale, with 0 requiring assistance and 4 performing the task independently. The maximal score of the BBS is 56 points. The authors note that the children are able to use their habitual braces and assistive devices as needed for the BBS.
- Static - Oscillations in Center of Pressure: using a Tekscan MatScan pressure platform system children were asked to perform a series of tasks, and their displacement or oscillations over their center of pressure was assessed. These tasks included standing with eyes open (EO) and eyes closed (EC) for 30 seconds each. Measurements of displacement were taken in the anteroposterior (AP) and the mediolateral (ML) axes. Children were asked to stand barefoot with their arms at their sides and heels aligned with their eyes fixed on a point.

Treadmill Test:

- Symptom-Limited Cardiopulmonary Effort Test: As there is no protocol for treadmill testing in pediatric populations with neurological disorders the authors utilized a symptom limited approach with a ramp protocol to increase speed. They started at 0.5 km/h and increased speed by 0.5 km/h each minute of the test. There were several criteria indicating the end of the test (maximal tolerance) to include: subjective sensation of fatigue, lower limb pain reported, complex heart arrhythmia, sudden increase or drop in blood pressure, increase above maximal heart rate for predicted age, intense shortness of breath and/or drop in oxygenation accompanied by electrocardiographic alterations or signs and symptoms. Every minute (next stage) the child was asked about their leg pain and shortness of breath using the BORG RPE scale. Blood pressure, electrocardiographic activity, and oxygenation was monitored throughout the test in 90-second intervals. This maximal effort that was then utilized to set parameters for walking speed for the experimental/walking group, however the test was performed on both groups.

1. Shirley Ryan Ability Lab. Pediatric Evaluation of Disability Inventory. Shirley Ryan Ability Lab. https://www.sralab.org/rehabilitation-measures/pediatric-evaluation-disability-inventory. Published March 22, 2017. Accessed September 13, 2020.

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.]

Table 2. Performance at baseline, posttreatment and follow-up of all outcome measures.

	Experimental group			Overground walking group		
	Baseline	Posttreatment	Follow up	Baseline	Posttreatment	Follow up
6'WT (m)	227.4 (49.4)	377.2 (93.0)*#	360.2 (86.1)*#	222.6 (42.6)	268.0 (45.0)*	257.6 (45.8)*#
Treadmill Test - Time(min) - Speed(km/h) - Peak HR (bpm)	 6.4 (1.3) 3.2 (0.6) 155.4 (14.0)	 9.8(1.9)*# 4.9 (0.9)* 117.0 (7.2)*	 8.9 (2.3)*# 4.2 (1.3)*# 118.4 (10.5)*	 5.0 (1.5) 2.5 (0.7) 153. (14.5)	 5.3 (1.8) 2.6 (0.9) 149.2 (13.2)	 5.1 (1.5) 2.5 (0.7) 148.9 (15.2)
TUGT (s)	14.3 (2.9)	7.8 (2.2)*#	8.6 (2.2)*#	12.8 (2.2)	10.5 (2.5)*	11.2 (2.5)*
PEDI - self-care - mobility - social function	128.0 (19.9) 42.8 (11.8) 33.0 (8.7) 52.2 (2.6)	139.0 (18.4)* 42.1 (10.5) 44.9 (7.7)*# 53.0 (2.3)*	140.8 (16.9)* 44.1 (10.2) 43.8 (7.1)*# 52.8 (2.7)*	120.8 (19.0) 38.5 (13.1) 30.3 (9.8) 52.0 (9.0)	125.8 (16.2)* 39.6 (12.3)* 33.8 (8.6)* 52.3 (6.3)	123.8 (17.4) 38.9 (12.7) 32.5 (8.5) 52.3 (2.3)
GMFM-88 (%) - subscale A(%) - subscale B(%) - subscale C(%) - subscale D(%) - subscale E(%)	81.6 (8.7) 93.1 (8.0) 92.9 (7.2) 87.8 (11.3) 60.5 (18.7) 72.1 (16.8)	93.0 (5.7)*# 96.2 (6.0) 94.3 (6.3) 95.7 (6.3)*# 84.4 (16.8)*# 92.3 (10.0)*#	91.7 (5.0)* 97.6 (4.0) 94.4 (6.2) 92.3 (6.3)# 82.4 (15.8)* 91.8 (9.5)*	77.3 (7.0) 92.5 (5.6) 94.7 (7.2) 83.6 (12.8) 54.2 (18.2) 61.6 (11.5)	80.8 (7.2)* 93.0 (5.4) 95.3 (6.6) 86.1 (11.3)* 61.9 (14.8) 69.4 (12.5)*	80.7 (7.5)* 92.5 (6.2) 95.1 (6.7) 85.9 (11.6)* 61.4 (14.7) 68.6 (12.0)*
BBS	34.9 (8.5)	46.7 (7.6)*#	46.2 (7.4)*	31.9 (7.0)	35.7 (6.8)*	35.6 (5.2)*
Oscillations in COP - AP-EO (cm) - AP-EC (cm) - ML-EO (cm) - ML-EC (cm)	 1.4 (0.0) 1.4 (0.3) 3.7 (1.4) 4.8 (0.6)	 1.0 (0.0)* 1.2 (0.0) 3.6 (1.3) 4.6 (1.4)	 1.7 (0.5) 1.3 (0.3)* 2.7 (1.1)* 3.5 (1.4)*	 1.1 (0.0) 1.2 (0.0) 3.6 (1.3) 4.6 (1.4)	 1.0 (0.0)* 1.1 (0.0)* 3.8 (0.6) 3.8 (1.0)	 1.1 (0.0) 1.1 (0.0) 3.6 (0.7) 4.1 (0.7)

* = ANOVA $p < 0.05$ (posttreatment and follow-up different from baseline)

\# = ANOVA $p < 0.05$ (posttreatment different from baseline)

Table 3. Comparison of different outcome measures evaluating the effects of treatment.

	Baseline - posttreatment				Baseline - follow-up			
	Experimental	Overground walking	Effect size	*p*	Experimental	Overground walking	Effect size	*p*
6'WT (m)	149.7 (122.3 - 177.1)	44.8 (34.2 - 55.3)	104.2	0.000*	137.6 (108.4 - 166.8)	33.6 (20.5 - 44.6)	104.2	0.000*
Treadmill Test Time(min) Speed(km/h) Peak HR (bpm)	3.3(1.9- 4.7)	0.3 (-0.6-1.3)	 3.0 1.5 22.3	 0.000* 0.000* 0.001*	2.4 (1.0-3.9)	0.1(-0.5 - 0.7)	 2.3 0.9 25.3	 0.000* 0.000* 0.001*

TUGT (s)	-6.4(-8--0.8)	-2.0(-3.2--0.8)	-4.3	0.004*	-5.7(-7.5--3.8)	-1.3(-2.2--0.4)	-4.4	0.005*
PEDI self-care mobility social function	11.0(-1.5-23.5) -0.6(-4.6-3.3) 11.9(10.2-13.5) -0.8 (-1.3--0.4)	4.0(2.7-5.2) 1.2(0.7-⅙) 3.7(1.6-5.7) -0.2(-0.5-0.0)	7.0 1.8 8.2 -0.6	0.035* 0.550 0.001* 0.434	12.8(10.0-15.6) 1.3(-0.3-3.0) 10.8(9.3-12.3) -0.6(-1.1--0.1)	3.1(0.9-5.3) 0.5(-0.1-1.1) 2.3(0.3-4.2) -0.2(-0.7-0.2)	9.7 0.8 8.5 -0.4	0.010* 0.223 0.000* 0.013*
GMFM-88 (%) subscale A(%) subscale B(%) subscale C(%) subscale D(%) subscale E(%)	11.3(8.0-14.7) 1.3(-1.8-4.5) 1.4(-0.213.1) 7.9(2.2-13.5) 23.9(17.0-30.8) 20.1(12.6-27.6)	3.6(0.9-6.2) -0.5(-1.8-0.7) 0.6(0.0-1.1) 2.4(1.0-3.7) 8.1(0.8-15.4) 8.2(2.1-14.3)	7.7 1.9 0.8 5.5 15.7 11.8	0.000* 0.131 0.666 0.007* 0.000* 0.000*	10.0(7.1-13.0) -3.3(-8.7-2.0) 1.4(-0.8-3.8) 4.4(0.2-8.7) 21.9(15.1-28.7) 19.7(12.1-27.2)	3.5(1.1-5.8) 2.3(-2.1-6.9) 0.3(0.0-0.6) 2.0(0.9-3.1) 7.6(0.7-14.4) 7.5(2.0-12.9)	6.5 5.7 1.1 2.4 14.3 12.1	0.000* 0.013* 0.764 0.071 0.001* 0.000*
BBS	11.8(8.8-14.7)	3.3(1.6-5.0)	8.4	0.000*	11.2(8.3-14.2)	3.2(1.3-5.0)	8.0	0.000*
Oscillations in COP AP-EO (cm) AP-EC (cm) ML-EO (cm) ML-EC (cm)	-0.08(-1.1-0.6) -0.07(-0.1-0.0) -1.2(-2.6-0.2) -1.4(-2.4-0.5)	-0.08(-0.1-0.0) -0.06(-0.1-0.0) 0.3(-0.5-1.1) -0.7(-1.7-0.3)	-0.006 -0.028 -1.5 -0.7	0.495 0.015* 0.002* 0.489	0.57(-0.83-1.9) -0.09(-0.1-0.0) -1.0(-2.3 - 0.3) -1.3(-2.0 - 0.6)	-0.03 (-0.1 - -0.1) -0.03 (-0.1 - -0.0) 0.1 (-0.6 - 1.0) -0.4 (-1.3 - 0.4)	0.609 -0.061 -1.1 -0.9	0.357 0.033* 0.011* 0.140

* = Independent t-test (posttreatment and follow-up)

* = p <0.05

After randomly allocating children into groups and assessing baseline anthropometric characteristics, no statistically significant differences were found between groups. As shown in Tables 2 and 3, both groups improved (walked further) in the primary outcome measure, the 6-minute walk test over the course of the 7 week intervention, both at posttreatment assessment and maintained at the follow up 1 month later. These improvements in distance were better at the posttreatment assessment, and while statistically significant improvements were still seen at follow up when compared to baseline, there was some decline in functional mobility in those 4 weeks after interventions concluded.

When considering baseline and interventions, as noted in Tables 2 and 3, greater improvements in distance walked during the 6-minute walk test was observed in the treadmill group at both posttreatment and follow up assessments when compared to the overground training group. In the TUGT, PEDI mobility section, subscales C and E of the GMFM (C: crawling and kneeling, E: walking, running and jumping), BBS, and treadmill test (time and velocity tolerated) both groups saw improvements at the posttreatment measurement, however this improvement was only maintained in the experimental group when measured again at followup. Additionally, when comparing between groups there were greater improvements in overall GMFM and PEDI scores and mediolateral oscillations with eyes closed in the experimental group when compared to the control in addition to the measures listed in the previous sentence.

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

When considering treadmill versus overground gait training options for children without the use of body weight support, 'both interventions led to improvements in functional mobility, gross motor function, functional performance and functional balance. However, better results were achieved with treadmill training (Discussion, pg 691).' The authors concluded that there is not a need for expensive or cumbersome body weight support equipment to provide gait training for children who fall within levels I - III on the GMFCS. They also concluded that treadmill training likely lead to greater results than the overground training group where children were able to self-select their speed because the treadmill is 'specific to the different phases of gait and offers controlled, constant velocity, thereby allowing rhythmic strides (Discussion, 694).' The authors also noted that gait training with the use of a treadmill is not to replace traditional therapy for children with cerebral palsy, but may serve as an additional modality to add to a therapists toolbox.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

As the authors noted they did not perform a gait analysis on the participants, so they are unable to make any conclusions as to whether treadmill versus overground training lead to changes in gait pattern. Additionally, the authors did not control for outside therapies or physical activity, and noted that physical improvements may have been a result in part of increased physical activity, regardless of what intervention the child received.They also note that they included children within the study that range from a GMFCS level of I-III and did not differentiate between levels, and that there is room for future research to determine level specific interventions.

A key strength of the study is that their methods are highly applicable to the clinical setting, especially since they did not use a body weight support system, as these are often very expensive and not available to many therapists in their clinics. Children were also able to use their supportive devices and orthoses, again making results applicable to children seen in the clinic.

Overall this study offers a fairly high level of evidence, as they went through efforts to ensure randomization of participants, concealment of group assignments, groups had similar baseline demographic characteristics, both groups received the same treatment frequency/duration, and the assessor was blinded. While there were 3 subjects that dropped out, the authors noted that each was due to either a hospital complication (respiratory issues) or a subject no longer meeting eligibility criteria. When considering generalizability and external validity I think the authors did a good job of making this as easily applicable to the clinical setting as possible - children were allowed to use assistive devices and orthoses, a treatment time of 2x/week for 30 minutes is not unreasonable, and finally, they did not use body weight support which makes it much more feasible to easily implement. The study results are believable, especially when we look at the between intervention results, as these interventions were so similar other than the surface they took place on, there was not large discrepancies or differences between the treatment received by one group. Additionally, when we are specifically considering the feasibility of implementing the treadmill protocol they give very explicit and clear instructions of how to perform the treadmill test, and subsequently set exertional goals for the treadmill gait training sessions.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

The results of this Grecco et al. give us further evidence that regardless of type, ground versus treadmill, gait training in children with cerebral palsy who use gait as their primary means of navigating their day is an important component of therapy, as they have the potential to make improvements in functional mobility via implementation of a fairly straightforward and simple gait training program - performing gait training 2x/week for 30 minutes at a time, attempting to reach a % of their maximal tolerance based on treadmill testing. Beyond this, these results give evidence that gait training on a treadmill versus overground walking may lead to greater gains in functional mobility and performance across several outcome measures of mobility, function, and balance, as well as maintain these improvements for greater lengths of time. While this intervention did not discern between various GMFCS levels, all of these children were ambulating as a primary means of function and this is where we are seeing primary improvements - for example in their ability to walk a further distance in a certain amount of time to keep up with their peers, or be less tired throughout the day as they are exerting less energy towards ambulation. Regardless of whether improvements are linked to the specific intervention provided or simply an increase in general physical activity, improvements in outcome measures and overall function are our goals as therapists.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

While the average age of the children included within this study was 6 and 6.8 across both groups, I do think that this has clinical application when specifically considering treadmill versus overground training in the school setting. 30 minute sessions 2x/week is reasonable for the county I was on clinical in. Additionally, this study is extremely applicable to the school setting as they did not utilize body weight support, which was not available within the school environment, so these results are particularly applicable for a school therapist who is likely considering treadmill versus overground without the option of a body weight support system. The parameters with which the treadmill protocol was administered could be easily reproducible within the school setting. Additionally, children were able to utilize their assistive device and orthoses, making results further applicable to this particular child who utilizes a posterior walker. When considering the clinical question this study was an excellent fit in assessing whether treadmill training would be more appropriate and effective than overground training as measured by the 6 minute walk test.

(2) Description and appraisal of (Over ground walking and body weight supported walking improve mobility equality in cerebral palsy: a randomized controlled trial) by (Swe et al., 2015)

Aim/Objective of the Study/Systematic Review:

The goal of the Swe et al. article is to gain a more clear understanding of if one method of gait training, overground or partial body weight supported treadmill training, is more effective in improving related outcome measures in children with mild to moderate cerebral palsy. While this has been looked into previously the authors determined there was not adequate power as well as inadequate protocols for appropriate dosage. To assess appropriate dosage the authors sought to determine how many weeks a gait training protocol should be via assessing at both 4 and 8 weeks to determine if further improvements can be attained by lengthening the intervention to 8 weeks.

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

This study is a randomized control trial, for which they utilized a block randomization technique to assign children to the control or experimental group. Assignments were kept confidential via opaque envelopes. The researcher responsible for allocating groups was kept blind to which intervention each child was assigned. To ensure equal participants in each group the researchers describe their technique, utilizing participant codes based on gender, age, and GMFCS level, then utilizing a random number table to assign each stratum. Outcome measures were assessed at baseline, midpoint (4 weeks), and at the conclusion of the intervention at 8 weeks. All outcome measures were completed by 2 experienced pediatric physical therapists who were blinded to each childs group allocation.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

This study took place at a special needs school in Singapore, specifically for children with cerebral palsy where the participants of the study were also recruited from. No further information was given on where in Singapore, or details of the school at which the intervention was performed and children were recruited. For those in the control group, overground walking, this walking took place within the corridors outside of the physiotherapy department at the school.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

Participants included children ages 6 to 18 with cerebral palsy that attend a Special Needs school in Singapore. These children all scored within the GMFCS levels II - III. Children from this school were ineligible to participate if they had visual impairment, a concurrent medical condition posing a safety risk, lower limb orthopedic surgery, or botulinum toxin injections within the last 6 months. Of the 37 children assessed for eligibility (n = 37) 7 were unable to participate due to child/parent denial, lack of outside class time, or inability to gain permission from the parents, leaving 30 total students to be enrolled within the study. There were no dropouts throughout the entirety of the study, all participants were followed up with at 4 and 8 weeks. The average age of participants within the study was 13.20 years old (see table 1), with a 2:1 ratio of males to females, and a greater number of children classified as GMFCS level II. Additionally, across groups there was a similar distribution of types of cerebral palsy including patients with (overground/treadmill): spastic hemiplegia (4/5), athetoid (3/2), spastic diplegia (5/7), spastic triplegia (2/0), and spastic quadriplegia (1/1).

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

Both the control and intervention groups participated in 2 sessions each week for a total of 8 weeks, with each walking practice lasting 30 minutes. Of note, this protocol was partially decided upon in order to co-inside with the school calendar. The overground walking group was considered the control group. These children were able to use their typical assistive devices as needed, with therapist assist to get into the assistive device as needed, as well as therapist assist with components of the gait cycle as needed throughout the session. Participants in both groups were asked to walk for a maximum of 30 minute, but could end the session earlier if they indicated they would like to stop, or they stopped stepping. During each of the training sessions participants were asked to continue walking at a faster pace, and for a longer duration if they did not meet the 30 minute maximum at previous sessions. Overground walking occurred within the school corridors outside of the physiotherapy department at the children's school. Due to school holidays, across groups each participant missed 3 sessions, totaling in 13 sessions overall.

Experimental

Throughout the course of the 8 week treadmill training protocol, participants has the goal of reducing the body support required, increasing the treadmill speed, and improving upright standing posture during ambulation to promote more ideal gait mechanics. A ceiling hoist with a pelvis/trunk harness was used to provide children with partial body weight support, how much support being determined at each individual session. Authors noted that the amount of body weight supported needed was decreased when children assumed a more upright standing posture during gait. Again the therapist was able to facilitate components of the gait cycle, as with the control group as needed. Minimal information was provided for how decrease in body weight support and increase in treadmill speed was determined objectively. The authors state that the treadmill training was 'graded progressively, incorporating aspects of reduced body weight support, increased speed, and increased duration as determined by each participant's ability and progress.' (Methods, pg 1110) Beyond this no information was provided on specifics the 2 therapists facilitating the treadmill session utilized to determine it was time to progress the child to less support or an increased speed, however it is stated that both physiotherapists are experienced in gait patterns and use of the treadmill. The initial speed at which the treadmill was set was determined by starting at the lowest possible treadmill speed (0.1 km/h) and progressing in increments of 0.1 km/hr until the child was taking steps forward comfortably. throughout each session the therapists would increase the speed as the child could tolerate, and then at each subsequent session the child would begin walking at the fastest recorded speed from the previous session, as tolerated, and breaks were provided as needed. At the start and end of each session children were given a warm up and cool down for 30 seconds, walking at a speed of 0.1 km/hr.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

Endurance - 6-minute walk (6mwt): The 6mtw was utilized in this study as a measure of endurance, in which children were asked to walk, not run, up and down a school corridor measured out to 30 meters, for 6 minutes. A physiotherapist was present only to provide encouragement for the to keep walking and to cover as much distance over 6 minutes as possible, but no assistance was provided to the child. The therapist recorded how long it took a child to complete each lap, as well as total distance covered.

Gait Speed - 10-meter walk test (10mwt): The authors indicated use of the 10mwt was appropriate in this population as children frequently need to walk short distances throughout the school day or at home, for example to walk between classes or to the bathroom. The 10mwt measures a child's walking speed, as they are asked to walk as quickly as possible for 10 meters, timed by a physiotherapist walking alongside them.

Gross Motor Function Measure (GMFM) - Subsets D and E: The GMFM was chosen as it illustrates changes in gross motor function over time, specifically for those children with a diagnosis of cerebral palsy. The older GMFM-88 version was utilized for this study rather than the GMFM-66. Each item within the subsets (subsets listed in 'Summary of Best Evidence, 1), Outcome Measures') is scored from 0-4. For this study children were only assessed on items number 52-88 (subsets D and E - standing and walking, running, and jumping).

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

Table 1. Demographics and baseline measures for the treadmill and overground training groups.

	Treadmill group (n=15)	Overground group (n=15)	overall (n=30)
Gender (m/f)	10/5	10/5	20/10
GMFCS (II/III)	10/5	8/7	18/12

Age (years)	13.03 (3.56)	13.37 (3.32)	13.20 (3.39)
10mtw (m/s)	0.922 (0.316)	0.805 (0.248)	0.864 (0.285)
6mwt (m)	223.33 (94.62)	205.00(88.58)	214.17(90.54)
GMFCS (D)	66.07 (22.28)	64.53 (16.29)	65.30 (19.19)
GMFCS (E)	41.07 (24.60)	40.47 (18.71)	40.77 (21.47)

Table 2. Training record of distance covered and time spent walking for treadmill and overground training groups.

		Treadmill group	Overground group	significance (P)
Distance (m)	Average Minimum Maximum	523.5 (307.6) 190.7 (98.1) 884 (355.7)	641.6 (300.2) 482 (221.3) 775 (367.1)	0.27 <0.001 0.69
Time (min)	Average Minimum Maximum	18.7 (6.9) 8.4 (2.5) 26.1 (3.4)	16.3 (2.4) 14.3 (1.8) 18.4 (2.3)	0.017 <0.001 <0.001

Table 3. Outcome measures at weeks 4 and 8 of training, and results of the ANOVA comparison with baseline.

		Treadmill	Overground	Time	Group	Time*group
10mwt (m/s)	Week 4 Week 8	1.031 (0.357) 1.082 (0.352)	0.852 (0.266) 0.978 (0.299)	F = 48.408, P < 0.001	F = 1.417, P = 0.244	F = 5.185, P = 0.012
6mwt	Week 4 Week 8	236.93 (96.12) 250.60 (110.86)	223.73 (98.77) 249.27 (107.84)	F = 26.057, P <0.001	F = 0.092, P = 0.764	F = 1.090, P = 0.350
GMFM (D)	Week 4 Week 8	71.47 (22.93) 77.73 (21.73)	71.27 (15.42) 79.13 (14.22)	F = 117.259, P < 0.001	F < 0.001, P = 0.967	F = 1.472, P = 0.247
GMFM (E)	Week 4 Week 8	46.73 (27.89) 54.13 (28.25)	57.40 (20.56) 56.33 (23.05)	F = 47.843, P < 0.001	F = 0.008 P = 0.931	F = 0.433, P = 0.653

All data provided in the tables above are mean (SD).

When considering baseline outcome measures as well as demographic characteristics, no significant differences were found between groups. Overall there were not significant difference among children across groups, indicating that group allocation or type of gait training did not impact outcomes. Time however, did show significant change, showing that across both groups regardless of the intervention received, outcome measures were improved with some form of gait training program. At the 4 week midpoint, the treadmill group showed advantage over the overground training in improvements in the 10mwt, however by the final assessment at 8 weeks both groups had similar levels of change. Other than the discrepancy at 4 weeks for the 10mwt, no other outcome measure showed any significant differences in change when comparing interventions.

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

Overall the authors concluded that regardless of the intervention received, children with mild to moderate disability as a result of cerebral palsy can see improvements in endurance, gait speed, and gross motor function in the areas of standing,walking, running, and jumping when participating in a gait training program that consists of either overground or partial body weight support treadmill training. Additionally, the authors concluded that significant changes can be made in a short intervention window of just 4 weeks, however additional gains can be made if interventions are prolonged up to 8 weeks. The authors noted that the use of body weight supported treadmill training may not provide any additional benefits over traditional overground walking protocols but they mention the Grecco et al. article above, noting that for children who are ambulatory treadmill training without support may be optimal and not needed to see optimal gains, however in children that need additional support this may not be an option. With the traditional method of training overground the author highlights advantages such as 'the ability to be conducted anywhere without the need for additional expensive equipment, and is a better representation of real life scenarios, which could potentially improve carry-over of functional improvements.' (Results, 1115) In favor of partial body weight supported treadmill training the author includes 'a greater number of steps can be performed within a single training session, task-oriented training can be performed, reduction of manual labor and elimination of prolonged non-ergonomic positions of the therapist, and the option of incorporation of virtual reality into training sessions, potentially making the training more enjoyable, especially for children.' (Results, 1115) Taking these pros and cons into account, and considering that no significant changes were noted between groups at the 8 week mark, the authors conclude that decisions should be made on an individual basis, in large part based on the severity of the child's disability.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

Before recruitment the authors performed a power calculation to determine how many participants they would need, using a clinically acceptable change in walking speed of 0.1 m/s, finding that 14 participants would be needed for each group, and adjusting for potential risk of dropout accordingly to reach a total n of 30.

A major weakness of the study is not having a specific protocol in place for treadmill training, as it makes implementing these principles harder for therapists to emulate. Additionally, as the authors noted, therapists may have been feeling cautious in the earliest stages of the treadmill training and did not ramp up the treadmill speeds enough, resulting in lower distances covered when compared to the overground walking group on the same weeks. An additional weakness for clinical carryover is the accessibility of partial body weight supported treadmill training in most pediatric therapy settings, as this may not be generalizable to most clinic settings, regardless of if it would benefit children more so than the overground treatment, it may not be financially reasonable. Additionally the authors note that they would have liked to incorporate comprehensive 3D kinematic and kinetic gait analyses as part of the outcome measures to determine if significant differences were found in gait parameters over the course of the intervention or across groups. As the authors note, it would have been interesting to follow up with the participants a few weeks after the interventions to assess whether there were differences in maintenance of gains made during the intervention after its completion, as previous studies have found that treadmill intervention may lead to prolonged gains. As noted with the previous study, as there was not a true control group that received no intervention, improvements seen across groups may be at least partially attributable to increases in general physical activity.

When considering the internal validity of the study the results do seem believable, especially since they mirror several previous studies that have been inconclusive in supporting one intervention for gait training over others. However when considering external validity, these results may be generalizable to other children with cerebral palsy, allowing clinicians to make more confident clinical decisions even when more expensive equipment such as a partial body weight support system is not available. As the authors note, assessment in children with more severe disability may be more relevant to this type of treadmill training, as they potentially seek to benefit from the partial body weight support more than children who are already ambulating as their primary form of mobility.

Overall this randomized control trial has high quality evidence, as they took most efforts to ensure blinding, adequate power, randomization, etc. - for a clinician with the option of partial body weight support treadmill training this study provides excellent evidence that treadmill training is effective, even if not more so than overground training, but as discussed in the results, each child ahs different needs and the treadmill may be a better fit for them than overground.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

When considering working with a child who has mild to moderate disability as a result of cerebral palsy (a child who walks independently, but may utilize assistive devices such as walker or crutches), overground walking or use of a body weight supported treadmill training program can lead to functional gains in endurance, gait speed, and functional mobility over the course of 4 to 8 weeks, with greater gains seen over a longer 8 week duration intervention. If possible in the clinic, it would be ideal to work with a child beyond the 4 week mark to continue to build upon gains, however if this is not possible due to time or insurance restrictions for example, significant changes in gait can still be observed after just 4 weeks. If a child has access too and it seems clinically appropriate to utilize the specific benefits of a body weight supported treadmill training system this is reasonable. I think the clinical significance of the study is potentially limited by the lack of access to this supportive treadmill system in many clinical settings, especially in light of the results indicating there is not necessarily a need for this equipment to see significant improvements. I would be much more inclined as a clinician to utilize treadmill training if i knew the gains would be carried over for a longer period of time, I would have been very interested to see follow up at a month or 2 out from the termination of the intervention to determine if there was additional skill maintenance in 1 intervention versus the other. Additionally, I would have liked to see more specific protocols in regards to the treadmill pacing and support provided, as too much support, or not pushing a child enough while on the treadmill belt could lead to declines in potential for functional improvements.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

In children who may be able to utilize a piece of equipment such as the Rifton Pacer Gait Trainer with the treadmill attachment I think these results are a starting point for potential future research on children with more severe disabilities as a result of cerebral palsy, higher than a GMFCS level of II to III. For my particular clinical question of a child that typically uses a posterior walker to navigate his way throughout school and home, and for which there was not access to a harness system such as the one utilizes in this study I would probably more practically utilize overground walking, or consider the previous Grecco study for treadmill training without the use of support. In the school system this 4 or 8 week protocol shows good evidence for improvements, and could be carried out fairly easily in the school setting. Ideally we would like to implement the longer program to see optimal benefits, but especially in the school setting, as the study found, school terms and vacations may not allow for this to always occur, so evidence supporting the use of a shorter program may be beneficial in these scenarios. For my particular clinical scenario, I thought the authors point of incorporating realistic and stimulating environments to practice walking in may lead to different challenges than walking on a treadmill, which for some children may be a detriment to their focus especially in early stages, but in my patient case he was easily distractible and this is when his gait suffered, so maybe additional practice would be helpful in more real-world scenarios.

SYNTHESIS AND CLINICAL IMPLICATIONS

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

Overall, these 2 studies utilized as best evidence were high quality randomized control trials, with PEDro scores of 8 and 9 respectively, indicating low risk of bias and appropriate measures taken to ensure randomization and blinding of those involved. Additionally, both of these studies directly addressed the clinical question: what is the best course of action for a child with cerebral palsy needing gait training within the school based setting? The Grecco et al article sought to determine if unsupported treadmill or overground training lead to improvements in functional mobility, gross motor function, functional performance and functional balance as well as if there was significant differences between groups at the end of the 7 week intervention, and at 1 month follow up. They concluded that both groups saw improvements in outcome measures, with greater improvements seen at completion of the intervention as well as at follow up in the treadmill training group. The Swe et al. article wanted to determine whether overground or partial body weight supported treadmill training was more effective in eliciting positive gait characteristic changes to include endurance, speed, and gross functional performance, as well as improvements were seen at 4 weeks, and if these gains continued to improve with a prolonged 8 week protocol. Overall Swe et al. concluded that both overground and partial body weight supported treadmill training resulted in improved gait characteristics, with no differences between groups. additionally, they concluded that significant changes were found at 4 weeks, but further improvements were attained when protocols were continued to 8 weeks duration.

Across both studies protocols were fairly similar, creating a good starting point for tailoring a gait training protocol for this clinical scenario, utilizing 2, 30 minute sessions per week, ideally for at least 8 weeks. In the school setting this frequency may be attainable, and if not parent/caregivers or outpatient based additional therapies may be able to become involved to meet a child's needs that cannot be fully attained due to school time limit restrictions.

Based on the results of the Grecco and Swe studies I would perform a treadmill test to determine maximal cardiopulmonary tolerance and establish appropriate goals for the percentage of tolerance reached during sessions to ensure the child is being pushed adequately without risking safety concerns. As this child does not currently have access to a partial body weight support treadmill system, the primary options are to utilize either overground training, or an unsupported treadmill protocol. As all interventions assessed resulted in significant positive outcomes for the children participating, and the Grecco article providing further evidence for unsupported treadmill training at program completion and at follow up, this is where I would lead my interventions for this clinical scenario.

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