CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

For an 18-month-old male with myelomeningocele, is powered mobility or gait training with orthotics and an assistive device more effective in preventing cognitive delay?

AUTHOR

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CLINICAL SCENARIO

The patient was an 18-month-old male diagnosed with myelomeningocele in utero. His L1/L2 lesion was repaired the day after his birth. He received early intervention physical and occupational therapy services due to bilateral lower extremity sensory and motor deficits (motor involvement was greater than sensory involvement). He was also demonstrating and receiving services for cognitive and communication delay. When this patient was met in a hospital setting, his home therapist had just introduced gait training with bilateral KAFOs and a walker. Upon the hospital therapist's physical therapy evaluation, he was able to stand and take a few steps with maximal trunk support without his orthotics or walker.

Early mobility allows children to explore and learn from their environments, contributing to cognitive development and even language skills.[1] Since this child was already demonstrating cognitive and communication delay, powered mobility may have been a valid treatment option when considering the severity of his physical impairments. The feasibility of using bilateral KAFOs and an assistive device exclusively for all mobility is poor; this child would likely need some form of powered mobility in addition to his orthotics and assistive device as he ages.[2,3] Because there are no power wheelchairs for children this young and small, adapted ride-on cars have become a popular option for this population. However, they are quite expensive. This scenario is relevant to clinical practice when needing to weigh the cost and the benefits of adapted ride-on cars versus traditional physical therapy interventions.

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

No literature currently exists comparing the outcomes of traditional gait training and powered mobility in pediatric populations with spina bifida or motor delay in general. Research studying outcomes following gait training or powered mobility interventions is available individually; however, the studies are limited in number, sample size, and study design. Of the eight studies identified as meeting inclusion/exclusion criteria, only two were systematic reviews (with one meta-analysis) and one randomized-controlled trial. Additionally, no studies directly measure cognition following either intervention of interest. Because early mobility has been associated with environmental exploration and cognitive development, study results demonstrating improvements in general mobility were applicable to this clinical scenario.[1] The results of one systematic review and meta-analysis suggest that treadmill training may be successful in accelerating attainment of motor skills for certain diagnoses, especially Down syndrome.[7] Another systematic review demonstrates that powered mobility may be effective in improving outcomes related to all domains of the International Classification of Functioning (ICF) Model, including cognition and general mobility.[5] Results must be interpreted with caution due to small sample sizes and lack of quality individual study designs in both reviews. Future research should seek to address these issues, especially by increasing sample size in order to increase power of results, and by utilizing studies of true experimental design.

CLINICAL BOTTOM LINE

While the clinical question cannot be answered directly with current evidence, including these results, powered mobility may be a more effective intervention for the patient compared to treadmill training. However, this is based upon available descriptive evidence rather than studies of high rigor and quality. If encountered in a clinical setting, both interventions should be presented to the patient and family, whose personal preferences and goals would be the ultimate factor for deciding which intervention to pursue.

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

The above information should fit onto the first page of your CAT

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
Myelomeningocele "Spina bifida" "Developmental delay" "Physical impairment" "Motor disabilit*" "Congenital disorder" Pediatric/s Children	"Power mobility" "Powered mobility" "Electric mobility" "Ride-on car"	"Gait training" Gait Orthotics "Physical therapy" Physiotherapy	"Cognitive delay" "Cognitive impairment" Cognition "Pediatric Evaluation of Disability Inventory" PEDI Prevent*

Final search strategy (history):

Show your final search strategy (full history) from PubMed. Indicate which "line" you chose as the final search strategy.

1. Myelomeningocele OR "spina bifida" OR "developmental delay"
2. "power mobility" OR "powered mobility" OR "electric mobility" OR "ride-on car"
3. "gait training" OR "physical therapy"
4. ("cognitive delay" OR "cognitive impairment") AND prevent*
5. #1 AND #2 AND #3 AND #4
6. #1 AND (#2 OR #3) AND #4
7. Myelomeningocele OR "spina bifida" OR "developmental delay" OR "motor disabilit*"
8. #7 AND (#2 OR #3) AND #4
9. "pediatric evaluation of disability inventory" OR PEDI OR cogniti*
10. **#7 AND (#2 OR #3) AND #9**

In the table below, show how many results you got from your search from each database you searched.

Databases and Sites Searched	**Number of results**	**Limits applied, revised number of results (if applicable)**
PubMed	**305**	**99 - Applied Filters: published in the past 10 years, English, Child: birth-18 years**
CINAHL	**309**	**66 - Applied Limiters: published since 2008, English, Age: all child**
Embase	**56**	**Not applicable**

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
Studied children with motor disability as a result of a congenital disorder
Compared powered mobility to physical therapy intervention
Studied powered mobility or physical therapy intervention
Assessed cognition before and after intervention using Pediatric Evaluation of Disability Inventory (PEDI) or similar outcome measure (with a domain pertaining to cognition)

Published in the past 10 years Published in English
Exclusion Criteria
Abstracts, letters to the editor, dissertations

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
Valentin-Gudiol, et al (2017)[7]	**AMSTAR Score: 11/11**	**Level 1a**	**Moderate**	**Systematic Review and Meta-Analysis**
Livingstone, et al (2014)[5]	**AMSTAR Score: 9/11**	**Level 3 (review of low quality studies)**	**High**	**Systematic Review**
Jones, et al (2012)[11]	**PEDro Score: 7/11**	**Level 2b (<80% follow-up)**	**High**	**RCT**
Huang, et al (2017)[9]	**Downs and Black Checklist: 16/26^**	**Level 3b**	**Moderate**	**Prospective, Non-Randomized Study**
Mattern-Baxter, et al (2016)[10]	**N/A; high RoB due to study design**	**Level 4**	**Moderate**	**Retrospective Analysis of a single group intervention (12 participants)**
Logan, et al (2018)[8]	**N/A; high RoB due to study design**	**Level 4**	**Moderate**	**Case Series (3 participants)**
Dunaway, et al (2013)[6]	**N/A; high RoB due to study design**	**Level 5**	**Low**	**Quasi-Experimental, time series design (single group intervention)**
Lynch, et al (2009)[4]	**N/A; high RoB due to study design**	**Level 5**	**High**	**Case Report**

^Scoring does not include power analysis

*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:

- **Valentin-Gudiol, et al (2017)[7]**
- **Livingstone, et al (2014)[5]**

These two studies represent the highest quality evidence for each intervention in the clinical question; Valentin-Gudiol et al addresses gait training, and Livingstone et al addresses powered mobility. This is important, since there are currently no studies comparing the two interventions of interest. Additionally, both articles review the body of available evidence for each intervention. There is one randomized-controlled trial included in the search summary that studied the effects of power wheelchairs on development and function. However, the study was quite limited by poor follow-up. Additionally, a large portion of participants had diagnoses with brain involvement, which could have a large impact upon outcomes related to cognition, and was not applicable to the patient in the clinical scenario. This randomized-controlled trial, along with two other studies in the search summary, is included in systematic review by Livingstone et al. By choosing the systematic review, the results of the randomized-controlled trial, as well as a case report of high relevance, were able to be captured in this CAT.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of: Treadmill Interventions in Children Under Six Years of Age at Risk of Neuromotor Delay by Valentin-Gudiol et al (2017)[7]

Aim/Objective of the Study/Systematic Review:

This purpose of this systematic review and meta-analysis is to determine whether gait training via treadmill intervention is effective in improving locomotor skills in children with delayed ambulation.

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 article is a systematic review and meta-analysis of randomized controlled trials and quasi-randomized controlled trials. It was built upon an original review conducted by Valentin-Gudiol et al in 2011.[12]
- Search Strategy: The databases searched include Cochrane, MEDLINE, Embase Ovid, CINAHL, PsycINFO, Science Citation Index Web of Science, PEDro, LILACS, ClinicalTrials.gov, WHO International Clinical Trials Registry Platform, CenterWatch, and metaRegister of Controlled Trials. The original search was performed in March 2011, and was performed again for the current review in July 2014, May 2016, and May 2017. The extensive search strategy for each database is included in Appendix 2, which included key words and MESH descriptors such as "physiotherap*," "treadmill or tread-mill," "locomotor* or locomotion*," "motor skills disorders," "gait ataxia," and "movement disorders." [7(p83-90)] The authors also considered studies included in other similar systematic reviews as well as references of articles produced by this search strategy.
- Selection Criteria: Articles were not excluded based upon publication status or language.
  - Inclusion:
    - Randomized controlled trials and quasi-randomized controlled trials
    - Participants were children </= 6 years of age with delayed ambulation or at risk of neuromotor delay
    - Studied the efficacy of treadmill interventions in improving gait parameters or level of assistance required with ambulation; studies could also be comparing parameters of different treadmill interventions (i.e. type or frequency)
    - Control group received either no intervention or a different, primary intervention seeking to improve ambulation; control group could be receiving treadmill intervention as a secondary treatment
  - Exclusion:
    - Children older than 6 years of age
    - Diagnoses for which physical activity is a contraindication
    - Studied outcomes not applicable to this review
    - Did not provide training prior to treadmill use
    - Had no control group
    - Ongoing studies
- Study Selection: For the original literature review, two groups of two authors screened all titles and abstracts according to inclusion criteria. Each group was assigned a mediator for the event of discrepancy.

For the updated review, three authors (all included in the original review screening) performed the screening of each article with one author assigned as a mediator.

- Data Collection: For the original literature review, four authors independently collected data using the same form. Two authors acted as mediators in the event of discrepancy. For the updated review, four authors (2 different from the original review) performed data collection.
- Risk of Bias: Risk of bias was assessed by two authors using Cochrane's tool for assessing risk of bias. A "Risk of bias" table, part of Cochrane's meta-analysis software, was generated with the data, which is provided in addition to rationale for each ranking. Publication bias was unable to be assessed due to the low number of studies qualifying for this review.
- Treatment Effect: Review Manager 2014, part of Cochrane's meta-analysis software, was used to calculate treatment effect. Because similar continuous data measurements were available in all studies, mean differences with 95% confidence intervals were able to be calculated for this data. Summary statistics for dichotomous data could not be calculated due to dissimilarities in the data across studies.
- Unit of Analysis: One cross-over trial was included in the review, for which the first phase alone (prior to cross-over) was included in the analysis.
- Missing Data: Dropouts for all studies were assessed and documented. Missing continuous data was analysed using the last observed data for given participants, if reported, or by only including subjects with final assessments. If standard deviations were not reported, the authors attempted to perform the calculations themselves. If this was not possible, the individual study authors were contacted.
- Heterogeneity & Data Synthesis: Heterogeneity was assessed for all studies and reported using I^2 and chi^2. Authors considered I^2 values >50% to be "substantially heterogeneous," and planned to provide a descriptive analysis should this value be found. [7(p95)] Subgroup analyses were able to be performed for three diagnoses: cerebral palsy, Down syndrome, and risk of developmental delay. A sensitivity analysis could not be performed due to the small number of studies included in this review and meta-analysis. Data synthesis was performed using a random-effects model and the inverse variance weighting method included in Cochrane's meta-analysis software.

Setting

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

Homes of participants or clinics; one study took place in Taiwan, while the remaining studies took place in the United States

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.

- Seven studies were included, with 175 participants total.
  - 97 participants received a treadmill intervention, while 78 participants were considered controls.
- Types of studies included:
  - One cross-over study,
  - Two quasi-randomized controlled trials,
  - Two randomized controlled trials without information regarding the randomization of participants,
  - Two randomized controlled trials with information regarding randomization of participants.
- Sample sizes of included studies ranged from 8 to 41 participants.
- Diagnoses included: preterm infants (born at <37 weeks or 259 days gestation) at moderate risk for developmental delay, cerebral palsy, general developmental delay (Z score >/= -1.5 on standardized developmental test), and Down syndrome.
- Age of study participants ranged from 7.6 months to 6.3 years.
- Both males and females were included across studies, but total number represented by each gender in this systematic review and meta-analysis is unable to be determined due to lack of comprehensive information provided by individual studies.
- Motor abilities at study commencement ranged from being able to sit independently for >30 seconds, take steps with under arm support, perform pull-to-stand, or ambulate with or without an assistive device.

Intervention Investigated

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

Control

- Subjects received either no intervention or a different, primary intervention seeking to improve ambulation
- Subjects could be receiving treadmill intervention as a secondary treatment

Experimental

- Subjects participated in treadmill interventions with the purpose of improving gait parameters or level of assistance required with ambulation
- The intervention was performed by either the child's parent(s) or therapist.
- Subjects could be receiving additional traditional physical therapy services (i.e. Early Intervention services)
- The main interventions used in the meta-analysis were:
    - Treadmill intervention vs no treadmill intervention,
    - Treadmill intervention with vs without orthotics,
    - High intensity vs low intensity treadmill intervention.

Outcome Measures

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

- Primary outcome measures used in the meta-analysis:
    - Age of onset of independent walking (measured in months)
    - Age of onset of walking with assistance (measured in days participating in study)
    - Gross motor function (measured by Gross Motor Function Measure as %)
- Secondary outcome measure:
    - Gait velocity
- Each of the studies reported several additional outcomes, such as specific gait parameters, which were documented in this systematic review and meta-analysis as well for completeness.
- Individual study outcomes were described as standardized measures, questionnaires, self-report data, data from motion analysis systems, or coded-video observations.
- Each outcome was evaluated by three study authors for risk of bias, quality (very low, low, moderate, or high), consistency, directness, and precision.

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.]

Findings were organized according to diagnosis due to differences in physical abnormalities experienced by each population. Additional outcomes were reported by individual studies and documented in this review, such step quality, step frequency, and step length. The following comparisons were reported in the study's meta-analysis:

Treadmill vs No Treadmill (compared in 5 studies)

- Age of onset of independent walking (months)
    - Risk of developmental delay: No significant difference between groups (p=0.50), -0.60 [95% CI -2.34, 1.14].
    - Down syndrome: Statistically significant greater improvement in treadmill group (p=0.008), -4.00 [95% CI -6.96, -1.04].
    - Overall effect: No significant difference between treadmill vs no treadmill intervention (p=0.22), -2.08 [95% CI -5.38, 1.22].
- Age of onset walking with assistance (days in study)
    - Down syndrome: Statistically significant greater improvement in treadmill group (p=0.02), -74.00 [95% CI -135.40, -12.60].
    - Risk of developmental delay: No significant difference between groups (p=0.86), -5.00 [95% CI -62.11, 52.11].
    - Overall effect: No significant difference between treadmill vs no treadmill intervention (p=0.26), -38.54 [95% CI -106.13, 29.05].
- Gross motor function (GMFM as %)
    - Spastic cerebral palsy: No significant difference between groups (p=0.58), 7.60 [95% CI -19.46, 34.66].
    - Risk of developmental delay: No significant between groups (p=0.83), 0.60 [95% CI -4.93, 6.13].
    - Overall effect: No significant difference between groups (p=0.75), 0.88 [95% CI -4.54, 6.30].
- Gait velocity

- General developmental delay: Statistically significant greater improvement in treadmill group (p=0.0045), 0.25 [95% CI 0.08, 0.42].
- Spastic cerebral palsy: No significant difference between groups (p=0.19), 0.18 [95% CI -0.09, 0.45].
- Overall effect: Statistically significant greater improvement in treadmill group (p=0.0019), 0.23 [95% CI 0.08, 0.37].

Treadmill Intervention With vs Without Orthotics (compared in 1 study)

- Age of onset of independent walking (months)
  - Down syndrome: No significant difference between groups, 0.10 [95% CI -5.96, 6.16].
- Gross motor function (GMFM as %)
  - Down syndrome: Statistically significant lower total GMFM scores in orthotics group after one month of intervention, -8.40 [95% CI -14.55, -2.25].

High-Intensity vs Low-Intensity Treadmill Intervention (compared in 1 study)

- Age of onset of independent walking (months)
  - Down syndrome: No significant difference between groups, -2.13 [95% CI -4.96, 0.70].
- Age of onset of walking with assistance (days in study)
  - Down syndrome: No significant difference between groups, -1.86 [95% CI -4.09, 0.37].

Original Authors' Conclusions

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

The benefits of treadmill training for children under six years of age may be dependent on diagnosis. While the power of this literature review is low due to number of available studies and sample sizes, results suggest that children with Down syndrome may have improved development of independent ambulation when using treadmill interventions. Additionally, according to findings outside of the main outcomes of this systematic review and meta-analysis, children with cerebral palsy or general developmental delay may improve attainment of motor skills following treadmill interventions. Further research must seek to improve the power of available studies, and eventually determine optimal dosage" of established treadmill interventions for each population.[7(p2)]

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.]

- This study received an 11/11 on the AMSTAR checklist.
- Strengths: Authors performed a rather comprehensive literature search, and detailed their search strategies along with their findings well. The process and tools used to assess the quality of each study was also documented well. While there was significant heterogeneity in specific outcome measures used across studies, the authors were able to find commonalities in major outcomes in order to perform a small meta-analysis. Because the authors organized individual study results by diagnosis, the results of this review can be applied to the different populations described.
- Weaknesses: The main weakness of this study relates to the number and quality of articles reviewed. Because the quality of studies reviewed is rather poor (i.e. two randomized controlled trials out of the seven studies reviewed did not describe randomization processes), the results of this review overall are not strong. However, this is also reflective of the availability of evidence related to this topic. Additionally, there was significant heterogeneity across studies (I^2 was >50% for all comparisons).
- Overall evidence quality: This systematic review and meta-analysis provides a comprehensive review of available evidence relating to treadmill training for populations described. While the study design itself is strong, the results are lacking in quality simply due to the quality of studies reviewed.

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.]

Overall, the amount and quality of evidence related to treadmill interventions for children at risk of neuromotor delay is lacking. The risk of bias for this meta-analysis is low, as demonstrated by its high AMSTAR score. However, there is significant risk of bias in the individual studies reviewed. Additionally, as reported in this review, many children in the intervention groups receiving treadmill training were receiving traditional physical therapy as well. Because of this, it is difficult to determine whether the improvements seen were due to the treadmill training or the adjunct therapy. The main results of this systematic review and meta-analysis suggest that treadmill interventions may be beneficial for specific patient populations, especially those with Down syndrome in regard to development of locomotor skills. However, this must be interpreted with caution due to rather large reported confidence intervals and significant heterogeneity between groups and interventions. More research is needed to add power to these findings and to further describe the efficacy of treadmill interventions in similar populations.

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.]

This systematic review and meta-analysis studied the efficacy of treadmill training for improving ambulatory skills. However, the patient in the clinical scenario was receiving gait training on natural surfaces using KAFOs and an assistive device. From this lens, the applicability of the study results to the clinical scenario is quite limited. The study did include children of similar age to the patient described in the clinical question, as well as males. Additionally, there were a variety of motor abilities present at the start of the studies reviewed, including those similar to the patient. There were no children included in this review with myelomeningocele, nor any other form of spina bifida. However, there were children included with general developmental delay as well as infants at risk of developmental delay, which may grant some applicability to the patient. The study's main findings indicate that treadmill training has no significant effect upon either of these populations in regard to age of independent walking, age of onset of walking with assistance, or gross motor function. While the systematic review and meta-analysis did not consider the impact of the environment upon study results, it is clinically important to note that the treadmill interventions were performed either in the clinic or in the child's home. For example, one home-based intervention was performed by the child's parents, while one clinic-based intervention was performed by a therapist with a body weight support system. Because the patient was receiving home-based physical therapy, the results of the clinic-based intervention with additional equipment may not be applicable, nor the intervention feasible. While this systematic review and meta-analysis did not directly consider the clinical question's outcome, the results do remain applicable due to the known effects of mobility upon cognitive development.[1] As mentioned previously, children with general motor delay did not demonstrate significant improvement in the main outcomes of this review. However, gait training through use of a treadmill could not confidently be excluded as a treatment option for the patient due to differences in diagnosis, specific interventions, and clinical settings reported in this review.

(2) Description and appraisal of: Systematic Review of Power Mobility Outcomes for Infants, Children and Adolescents with Mobility Limitations by Livingstone and Field (2014)[5]

Aim/Objective of the Study/Systematic Review:

"To summarize and critically appraise the evidence related to power mobility use by children (aged 18 years or younger) with mobility limitations and to identify and classify outcomes according to International Classification of Functioning (ICF) components." [5(p2)]

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.

- Systematic review
- Methods: The study's two authors independently performed the database search, screened study titles and abstracts, and decided whether the articles met inclusion criteria. The search was not limited by study design nor publication status. In the event of disagreement, the authors came to conclusions through discussion without the intervention of a third party.

- Search Strategy: The databases searched include OT Seeker, PEDro, EBM Reviews, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), ACP Journal Club, CINAHL, Medline EBSCO, Medline OVID SP, EMBASE, PsychInfo, and ERIC. The search spanned the entirety of each database's existence through September 2012, and was repeated in June 2013 and February 2014. The search included the key words power* mobility, power* wheelchair, wheelchair/powered, and child. Limits such as 'childhood' and 'adolescence' were applied according to available database filters. Appendix A, provided in the supplementary material of this review, contains the detailed search strategy in addition to article retrieved from each search. The authors also considered studies included in other similar systematic reviews as well as references of articles produced by this search strategy.
- Selection Criteria:
  Inclusion:
    - Quantitative studies published in peer-reviewed journals
    - Included at least one child <19 years of age with a motor disorder related to a neurological, musculoskeletal, or neuromuscular condition
    - Detailed outcomes following use of power mobility

  Exclusion:
    - Qualitative methods used
    - Not in English
    - Included only typically developing children
    - Included outcomes that could not be specifically attributed to children with a disability
    - Did not specifically describe outcomes related to power mobility
    - Focused on development of technology or measurement tools
    - Non-peer reviewed sources (i.e. conferences proceedings, dissertations)
- Data Collection: The two authors extracted data using the McMaster critical review form for quantitative studies. All studies were assigned a level of evidence according to the American Academy or Cerebral Palsy & Developmental Medicine (AACPDM) Levels of Evidence protocol.

Setting

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

Examples of study settings were not specified. Based upon results described in Tables 5-7 of the Supplementary Material as well as duration of interventions mentioned, it is inferred that interventions took place in clinic, home, and school settings.

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.

- 29 articles met inclusion criteria. Because one individual study was published as two separate articles (each focusing on different outcomes), the 29 articles actually represented 28 studies total.
- Types of studies included:
    - Case studies (n=15),
    - Cross-sectional studies (n=5),
    - Single-subject designs (n=2),
    - Cohort without control (n=2),
    - Non-randomized pre-test/post-test designs (n=1),
    - Mixed methods (n=1),
    - Case series (n=1),
    - Randomized-controlled trial (n=1).
- Sample sizes of included studies ranged from 1 to 96 participants.
- Diagnoses included: muscular dystrophy, cerebral palsy, osteogenesis imperfecta, spina bifida, spinal cord injury, Down syndrome, and spinal muscular atrophy
- Age of children ranged from 7 months to 18 years.

Intervention Investigated

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

Control

The majority of included studies did not have control groups due to study design. For the few with control groups, the details were not described.

Experimental

- Subjects participated in an intervention using some form of powered mobility.
- Devices used across studies included power wheelchairs (20 studies), devices designed specifically for very young children (i.e. a toy car - five studies), Smart Wheelchairs (three studies), and one specialized system.

Outcome Measures

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

- American Academy or Cerebral Palsy & Developmental Medicine (AACPDM) Levels of Evidence protocol
    - Within this protocol, studies may be assigned Level I, indicating high likelihood that the intervention is truly responsible for the outcome, through Level V, indicating only association between the intervention and outcome.
    - For studies assigned Levels I-III, a quality rating may also be assigned (strong, moderate, or weak).
- International Classification of Functioning (ICF) Model
    - Outcomes of interest across included studies were classified as addressing Body Structure and Function, Activity, or Participation

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.]

AACPDM Levels of Evidence Protocol

- Studies reporting outcomes related to Body Structure and Function:
    - Level I = 0 studies
    - Level II = 1 study
    - Level III = 0 studies
    - Level IV = 5 studies
    - Level V = 8 studies
- Studies reporting outcomes related to Activity:
    - Level I = 0 studies
    - Level II = 1 study
    - Level III = 1 study
    - Level IV = 4 studies
    - Level V = 22 studies
- Studies reporting outcomes relates to Participation:
    - Level I = 0 studies
    - Level II = 0 studies
    - Level III = 0 studies
    - Level IV = 3 studies
    - Level V = 8 studies
- Quality ratings for Level II and III studies
    - Jones et al (2012) - Strong
    - Butler (1986) - Moderate

ICF Model Components Addressed with Interventions

- Body Structure and Function (14 studies): heart rate, IQ, motor level, affect, engagement, sleep/wake pattern, eating, developmental change, and psychological impact
- Activity (28 articles): general mobility, self-initiated mobility, interaction with objects, verbal communication, independence, driving time and distance, general communication, cause-effect, and hand use
- Participation (11 articles): social interaction, play skills, social skills and interaction, peer participation, social roles, responsibility and play skills

Tables 5-7 in the Supplementary Materials provide results of individual studies related to their specific outcomes of interest. A few of the studies used assessment tools with multiple domains, including cognition (Body Structure and Function) following use of powered mobility. Several studies also measured general mobility (Activity). Overall, the individual results report positive outcomes related to these measures; however, the results provided are generally narrative without supporting data.

Original Authors' Conclusions

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

While the body of available evidence related to powered mobility for children is "descriptive rather than experimental," [5(p1,9)] it may still be effective intervention for improving outcomes related to all domains of the ICF model.

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.]

- AMSTAR score: 9/11. 'A priori' design: Yes; Two independent data extractors: Yes; Comprehensive search: Yes; Status of publication: Yes; List of studies: Yes; Quality of studies documented: Yes; Quality of studies used in conclusions: Yes; Appropriate methods: NA; Publication bias assessed: No; Conflict of interest included: Yes.
- Strengths: Authors gathered a large body of literature related to powered mobility use in children. They also organized a variety of outcomes being studied, as well as study results, related to powered mobility. The studies included in this review describe a number of different diagnoses, which makes the results applicable to several different patient populations.
- Weaknesses: Authors reported an attempt to minimize publication bias; however, they did not state the method used in this attempt. Additionally, studies were excluded if not published in English, which is a major limitation especially for a topic related to current technology. Because of the limited key words used in the search strategy, bodies of older published literature may have been missed due to changes in terminology related to powered mobility. This study also has inherent weakness due to the low quality of evidence reviewed. However, this may be reflective of the majority of evidence related to this topic. While unrelated to the study design, available information regarding the few control groups was not included. The authors also did not mention whether children receiving powered mobility interventions were receiving any other interventions, such as traditional physical therapy, simultaneously.
- Overall evidence quality: This systematic review provides a substantial amount of evidence and number of outcomes related to powered mobility for children across several diagnoses. The study design is relatively strong; however, results may be limited due to potential for articles to have been overlooked on the basis of language, limits in search strategy, and poor quality of individual studies.

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 body of literature reporting outcomes following powered mobility interventions in children with motor delay is limited in quality and quantity. For example, over half of the evidence reported in this systematic review was represented by case studies. This makes it difficult to determine whether powered mobility is preferable to other interventions directed at improving early mobility. The findings of this systematic review do suggest that powered mobility may have a desirable impact on outcomes related to Body Structure and Function, Activity, and Participation domains of the ICF Model. Additionally, this systematic review demonstrates these positive outcomes in a large variety of diagnoses. Despite these findings, the study results may not be truly reflective of the entire body of evidence related to powered mobility for children with motor delay for reasons described above.

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.]

This systematic review included children of similar age to the patient described in the clinical question, but did not give information regarding gender of participants nor clinical setting of interventions. There were several studies that included participants diagnosed with spina bifida; however, the type of spina bifida was not specified. No studies included in this systematic review compared powered mobility to gait training. However, several included studies reported positive outcomes related to cognition following use of powered mobility. This fell into the study results categorized as the Body Structure and Function domain of the ICF Model. For example, Jones et al reported improved cognition as measured by the cognitive domain of the Batelle Developmental Inventory (BDI).[13] Lynch et al found improved cognition as measured by the Bayley Infant & Toddler Scales of Development, Third Edition (Bayley III).[4] As mentioned previously, early mobility contributes to cognitive development.[1] The results of this systematic review describe increases in functional mobility skills, self-initiated movement, independent mobility, and mobility as a whole following use of powered mobility. Each of these outcomes were categorized within the Activity domain of the ICF Model, and were measured using assessment tools such as the PEDI and Powered Mobility Program. These results demonstrate applicability, and promising results, to the outcome of interest in the clinical question. The overall applicability of the study results, and the feasibility of using powered mobility as an intervention, is limited by the lack information regarding clinical setting. Additionally, even if the majority of studies did occur in the home of participants, powered mobility may not be feasible for the patient due to the size or accessibility of the family's home. A final consideration for the patient is the fact that gait training had already been initiated by his home therapist. Because the systematic review did not indicate whether subjects receiving powered mobility interventions were also receiving traditional physical therapy, it cannot be determined whether his traditional therapy would need to be continued simultaneously. Weighing these factors along with the results of this study, powered mobility may be considered as a treatment option for the patient in the clinical scenario.

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.]

In general, the two studies reviewed for this CAT were comprised of rather low quality evidence. However, this seems to be reflective of the body of literature surrounding gait training and powered mobility for children with motor delay. The quantity of available evidence is low, and the evidence that does exist is lacking in sample size and experimental design. Both studies reviewed articles including several different diagnoses, which expands the breadth of applicability of study results. However, both studies were limited by potential publication bias due to limits applied to language of publication and/or inadequate variability of search terms used. Had efforts been made to negate these potential sources of bias, a more comprehensive or conclusive outcome may have been established by both studies. This is especially important, as the topics reviewed in both studies are quite current within the global world of rehabilitation and technology.

Both studies demonstrate some applicability to the clinical scenario presented. With respect to individual patient factors, participants of similar age, diagnosis, and physical ability to the patient were included across individual studies. However, neither review explicitly compared the two interventions of question in the clinical scenario. The applicability of results reported by Valentin-Gudiol et al is limited, simply due to the fact that the patient in the clinical scenario was receiving gait training with orthotics and an assistive device. The results reported by Livingstone and Field are also limited in applicability due to the lack of information regarding treatment received as an adjunct to the powered mobility interventions. For example, perhaps the family of the patient in the clinical scenario opted to pursue powered mobility, but could not afford simultaneous sessions for gait training. If participants in the studies were actually receiving gait training in addition to the powered mobility interventions, and the gait training was contributing to desirable changes in outcomes, the child and family would be at a disadvantage. While neither study considered cognitive delay as a single outcome of interest, the outcomes described in both studies remain applicable to the clinical scenario. For example, Valentin-Gudiol et al reported that increases in locomotor skills may result in improved mobility for certain populations; based upon the widespread effects of early mobility, these improved locomotor skills may also improve cognition.[1] Additionally, measurement tools including domains related to cognition, as well as general outcomes related to mobility, were considered by Livingstone and Field.

The results of the systematic review and meta-analysis by Valentin-Gudiol et al suggest that the patient in the clinical scenario may not benefit from treadmill training. However, this must be considered with caution clinically; no patients specifically diagnosed with spina bifida were included in the review. Additionally, the intervention of interest was different from the gait training being received by the patient. The results of the systematic review by Livingstone and Field suggest that powered mobility may positively impact outcomes related to several different domains of the ICF Model, including cognition. However, it is unable to be determined whether this intervention could be performed individually, or whether additional interventions would be required simultaneously.

Ultimately, the clinical question cannot be answered with confidence using existing evidence, including the two studies reviewed for this CAT. When considering the results of these two studies, powered mobility may be superior to treadmill training for the patient in this clinical scenario. However, this is based upon objective

patient factors and descriptive results rather than study rigor or quality, which is generally poor. If this decision was to be made in a true clinical setting, both treatment options would need to be presented, and the patient and family's personal goals and preferences would be the ultimate factor for deciding which option to pursue. Future research is critical to providing conclusive results for this topic. First and foremost, studies must include greater sample sizes in order to increase the power of study results. Additionally, experimental studies including true control groups are needed in order to determine the effectiveness and, eventually, superiority of interventions. Finally, the design of future research must control for effects of outside treatments. Because powered mobility is quite expensive, families and therapists must know how likely this investment is to cause desirable changes in outcomes.

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