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Annual
Doctor of Physical Therapy
Research Presentations

Friday, November 2, 2018, 5:30 PM to 9 PM, DeNaples Center 4th Floor Moskovitz Theater

The University of Scranton has pre-approved provider status with the PA State Board of Physical Therapy. The PA State Board of Physical Therapy has ultimate authority to the determination.

This course is approved for 3 general contact hours. However, you must attend the entire session to receive credit.

University of Scranton Physical Therapy:
http://www.scranton.edu/academics/pcps/physicaltherapy

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Schedule of Events

Introduction: Dr. Tracey L. Collins

Group 1:
Effectiveness of Gait Interventions in Improving Gait in Adults with Ataxia: A Systematic Review

Lauren Bonitz, Megan Fasano, Meghan Goyden, Caroline Segota, Dr. Jennifer Schwartz

Group 2:
The Effects of Blood Flow Restriction Therapy on Physical Performance in Adults as Compared to Standard Physical Exercise and Control Groups: A Systematic Review

Omar Amer, Berta Carmo, Dannylyn Manabat, Jonathan L. Mayes, Dr. Peter Leininger

Group 3:
The Impact of Home Health Care on Cost Effectiveness Compared to Other Post-Acute Settings in Individuals Status Post Total Joint Arthroplasty: A Systematic Review

William Cavanaugh, John Huller, Nicholas Mullery, Joseph Pichiarello, Dr. Tracey L.Collins

Group 4:
The Effects of Intramuscular FES on Objective Gait Measures in Adult Patients with Chronic Stroke: A Systematic Review

Levi Haldeman, Lisa Jackowitz, Aaron Oquendo, Matthew Wells, Dr. Renee M Hakim

Group 5:
The Effect of Transcranial Direct Current Stimulation on Balance and Mobility in Children with Cerebral Palsy: A Systematic Review

Courtney Jo James, Danielle Frank, Krista Ziegler, Sarah Kosik, Dr. Nicholas Rodio, Dr. Renee M. Hakim

Individual Research
The Use of Cognitive Behavioral Therapy on Patients with Chronic Pain in Home Health Physical Therapy: A Systematic Review

Maura McGowan, Dr. Tracey L. Collins

SHORT BREAK

Individual Research
The Effect of Home Health Care in Reducing Hospital Readmissions: A Systematic Review

Lindsay McGraw, Dr. Tracey L. Collins

Group 6:
The Effect of Equine Related Therapy on Physical and Psychological Well-Being of Older Adults: A Systematic Review

Maria Gentile, Shannon McSherry, Devin Ryan, Cassie Lucke, Dr. Jennifer Schwartz, Dr. Dana Maida

Group 7:
A Systematic Review of the Effects of Early Mobility in Reducing Length of Stay for Adult Patients in the Intensive Care Unit Due to Trauma

Stephanie Klug, Molly Loftus, Stephanie Zaccaria, Dr. Dana Maida, Dr. Janette Scardillo

Group 8:
How is Graded Exercise Testing Being Used in the Clinical Management of Individuals Following a Concussion: A Systematic Review

Kevin Whelan, William Wilcox, Alissa Zajac, Dr. Janette Scardillo

Group 9:
Effects of Combined Skilled Aquatic and Land Based Therapy Compared to Land Therapy Alone on Balance and Gait in Adults after a Stroke: A Systematic Review

Megan J. Manzo, Gianna M. Vitolo, Colleen E. Smith, Emily M. Suchocki, Dr. Peter Leininger

Group 10:
The Effect of Virtual Reality Training on Balance and Mobility in Adults with Moderate to Severe Traumatic Brain Injury: A Systematic Review

Jamie Christensen, Maura McGowan, Lindsay McGraw, Cory Piening, Dr. Renee M. Hakim

All Evidence is not Created Equal

http://www.orthopaedicprotocols.com/wp-content/uploads/2011/03/EBPRACT.pdf

PEDro is a critical appraisal tool intended to identify methodological flaws in the physical therapy literature providing consumers of research evidence objective data regarding the strength of such evidence.

Study	1	2	3	4	5	6	7	8	9	10	11	Score
Grade												

1. Eligibility criteria were specified.
2. Subjects were randomly assigned to groups.
3. Allocation was concealed 4. Groups were similar at baseline.
5. Subjects were blinded.
6. Therapists who administered the treatment were blinded.
7. Assessors were blinded.
8. Measures of key outcomes were obtained from more than 85% of subjects.
9. Data were analyzed by intention to treat.
10. Statistical comparisons between groups were conducted.
11. Point measure and measures of variability were provided.

Criteria number 1 is not used to generate the total score. Therefore, the total maximum score is 10.

http://www.pedro.org.au/english/downloads/pedro-scale/

Sackett Levels of Evidence

Level of Evidence	Description
1A	Systematic review of randomized controlled trials (RCTs).
1B	RCTs with narrow confidence intervals.
1C	All or none case series.
2A	Systematic review cohort studies.
2B	Cohort study/low quality RCT.
2C	Outcomes research.
3A	Systematic review of case-controlled studies.
3B	Case-controlled study.
4	Case series, poor cohort case-controlled study.
5	Expert opinion.

Fletcher and Sackett, working for the Canadian Task Force on Periodic Health Examination in 1979, are credited as the first to develop a level of evidence scoring scale. Sackett continued to develop the scale based on his own research with the use of anti-thrombotic agents.
http://www.physio-pedia.com/Grades_and_Levels_of_Evidence

MINORS Scale

Table 2. The revised and validated version of MINORS

Methodological items for non-randomized studies	Score†
1. **A clearly stated aim:** the question addressed should be precise and relevant in the light of available literature	
2. **Inclusion of consecutive patients**: all patients potentially fit for inclusion (satisfying the criteria for inclusion) have been included in the study during the study period (no exclusion or details about the reasons for exclusion)	
3. **Prospective collection of data**: data were collected according to a protocol established before the beginning of the study	
4. **Endpoints appropriate to the aim of the study**: unambiguous explanation of the criteria used to evaluate the main outcome which should be in accordance with the question addressed by the study. Also, the endpoints should be assessed on an intention-to-treat basis.	
5. **Unbiased assessment of the study endpoint**: blind evaluation of objective endpoints and double-blind evaluation of subjective endpoints. Otherwise the reasons for not blinding should be stated	
6. **Follow-up period appropriate to the aim of the study**: the follow-up should be sufficiently long to allow the assessment of the main endpoint and possible adverse events	
7. **Loss to follow up less than 5%**: all patients should be included in the follow up. Otherwise, the proportion lost to follow up should not exceed the proportion experiencing the major endpoint	
8. **Prospective calculation of the study size**: information of the size of detectable difference of interest with a calculation of 95% confidence interval, according to the expected incidence of the outcome event, and information about the level for statistical significance and estimates of power when comparing the outcomes	
Additional criteria in the case of comparative study	
9. **An adequate control group**: having a gold standard diagnostic test or therapeutic intervention recognized as the optimal intervention according to the available published data	
10. **Contemporary groups**: control and studied group should be managed during the same time period (no historical comparison)	
11. **Baseline equivalence of groups**: the groups should be similar regarding the criteria other than the studied endpoints. Absence of confounding factors that could bias the interpretation of the results	
12. **Adequate statistical analyses**: whether the statistics were in accordance with the type of study with calculation of confidence intervals or relative risk	

†The items are scored 0 (not reported), 1 (reported but inadequate) or 2 (reported and adequate). The global ideal score being 16 for non-comparative studies and 24 for comparative studies.

The items are scored 0 (not reported), 1 (reported but inadequate), or 2 (reported and adequate).

MINORS is a valid instrument designed to assess the methodological quality of non-randomized studies, whether comparative or non-comparative.

Title: Effectiveness of Gait Interventions in Improving Gait in Adults with Ataxia: A Systematic Review

Authors: Lauren Bonitz, SPT; Megan Fasano, SPT; Meghan Goyden, SPT Caroline Segota, SPT; and Jennifer Schwartz, PT, DPT, Board-Certified Clinical Specialist in Neurologic Physical Therapy

Purpose/hypothesis: The purpose of this study was to determine the most effective gait intervention to improve gait in patients with ataxia.

Summary of methods: A literature search (2008-2018) of CINAHL, Health Source: Nursing/Academic Edition, MEDLINE/PubMed, and ProQuest was conducted using the search terms: ataxia AND (gait training or locomotion training or gait rehabilitation). Search limits: English, human subjects and peer reviewed. Selection criteria: adults (≥18 years) with ataxia, objective gait measures, and gait intervention. Two reviewers independently assessed each study for methodologic quality and reached consensus using Sackett guidelines.

Results: 55 articles were evaluated for eligibility, yielding 9 studies after application of selection criteria. Sackett levels ranged from IB-V (1 RCT, 3 pre-post design, 5 case reports). Studies included subjects with ataxia (ages 19-81) due to: acquired brain injury (TBI, CVA or infection) or degenerative cerebellar changes. Samples ranged from 1-19 participants (n=58). Interventions included: treadmill training, body weight support, dynamic gait training, auditory cueing, and conventional gait training. Intervention parameters varied widely from 1-60 sessions lasting 10-240 minutes. Duration of the interventions ranged from 1 day-20 weeks. 9 studies found statistical and/or clinical improvements in objective gait measures such as spatio-temporal gait parameters (including 10MWT), complex gait (TUG, DGI), ataxia (Scale for Assessment and Rating of Ataxia), independence (Functional Ambulation Category) and gait quality (Rivermead Visual Gait Assessment).

Conclusion: Results of this systematic review reveal that there is mixed evidence supporting task-specific gait interventions for adults with ataxia. There is high quality evidence (IB) that therapist assisted gait training is equally as effective as robot assisted gait training in adults with ataxia to improve complex gait with reduced ataxia. There is low evidence (IV-V) that treadmill training (with and without obstacles), body weight support, auditory cueing, and dynamic gait training can improve gait in adults with ataxia as evidenced by significant improvements in complex gait (2 studies), spatio-temporal parameters (6 studies), ataxia (2 studies), independence (2 studies), and gait quality (1 study). Limitations included small samples, poorly defined gait interventions, and lack of uniform outcome measures, control groups and long-term follow up. Future research is needed to determine ataxia-specific gait outcome measures and interventions and address the above limitations.

Clinical relevance: Historically, ataxia has been treated by weighting the patient's trunk and lower limbs and through symptom management at the impairment level. This systematic review suggests that gait-specific rehabilitation strategies can be effective addressing ataxia at a functional level. When working with adults with ataxia, clinicians should consider task-specific gait training to address individual functional mobility deficits.

Summary of Interventions

Intervention	Sample Size	Intervention Parameters	Duration	Outcomes Improved
Robot assisted gait training vs. therapist assisted gait training	N=15	60 mins. 3 x per week	5 months	Complex gait (TUG), Ataxia (SARA)
Conventional gait training (with weight shifts, verbal cuing, etc.)	N=19	1.5 hrs. 2 x per week	12 weeks	Spatio-temporal gait parameters (COM displacement, gait speed, step length/width, stance time)
Partial Body Weight Support	N=8	50 mins. 2 x per week	18 weeks	Complex gait (DGI)
Treadmill training (with visual cues)	N=10	1 hrs. 10 sessions	5 weeks	Ataxia (SARA)
Conventional gait training (with trunk stabilization)	N=1	60-90 mins. 28 sessions	22 weeks	Spatio-temporal gait parameters (10 MWT), Independence (FAC)
Dynamic Gait (obstacle course, gait with head turns, stop and goes)	N =1	1.5-2 hrs. 5 x per week	12 weeks	Complex gait (DGI), Spatio-temporal gait parameters (gait velocity)
Conventional gait training (trunk stabilization, physical conditioning)	N=1	30 min. 5 x per week	2 months	Ataxia (SARA), Independence (FAC)
Auditory cueing (metronome)	N=1	1 session not specified	1 day	Spatio-temporal gait parameters (Step time, stance time, double support time, step length)
Treadmill training (with visual cues)	N=2	30 mins. 3 x per week	7 weeks	Spatio-temporal gait parameters (Step length, cadence, speed) Complex gait (TUG), Gait quality (TUG, RVGA)

Title: The effects of blood flow restriction therapy on physical performance in adults as compared to standard physical exercise and control groups: Systematic review.

Authors: Omar Amer SPT, Berta Carmo SPT, Jonathan L. Mayes SPT, Dannylyn Manabat SPT, Peter M. Leininger PT, PhD, OCS

Purpose/Hypothesis: The purpose of this systematic review was to determine the effects of blood flow restriction therapy (BFRT) on physical performance in adults as compared to standard exercise protocol or no exercise.

Materials/Methods: A literature search of ProQuest, PubMed, Cochrane Library, CINAHL, and Google Scholar included search terms: (Blood Flow Restriction OR BFR OR Blood Flow Occlusion OR Blood Flow Restriction Therapy OR BFRT) AND (adults) AND (walking OR ambulating OR ambulation OR gait). Search Limits: peer-reviewed studies (2008-2018), English, and human subjects. Selection criteria: otherwise healthy (excluded: history of blood clots, cardiovascular disease, peripheral vascular disease, smoking, etc.) adults ≥45 years, BFR training, physical performance and/or mobility and/or strength outcomes, and RCTs. Two reviewers independently assessed each article for methodological quality and came to consensus based on PEDro guidelines.

Results: A total of 968 articles were screened for eligibility and 5 articles met selection criteria. PEDro scores were all 6/10. Sample sizes ranged from 18-37 participants (121 total; aged 50-80 years). BFRT intervention ranged from 18 to 40 total sessions (10-45 min) over 6 to 10 weeks duration for 3-5 times/week. Blood flow restriction was applied (4 studies with LE and 1 study with UE) with pressure ranging from 96-240 mmHg. Outcome measures assessed physical performance (TUG, 30 sec sit-stand, biodex system, 1 repetition (rep) max (1RM)). All 4 studies that measured the TUG showed statistically significant improvement with BFRT (3 comparing BFRT to control and 1 comparing BFRT to high intensity training (HIT) and control). All 4 studies that measured the 30 sec sit-stand showed statistically significant improvement with BFRT (3 comparing BFRT to control and 1 comparing BFRT to HIT and control). All 3 studies that analyzed strength demonstrated improvements with BFRT compared to control groups.

Conclusions: There is moderate to strong evidence in support of BFRT to improve physical performance in adults.

Limitations included small samples sizes, TUG distance variations, inability to blind subject, assessor, and therapists, and differences in BFR parameters. Future RCTs should focus on determining the optimal parameters (frequency, duration, intensity) and long-term effects of BFRT, would prove enlightening.

Clinical Relevance: Clinicians should consider BFRT with selected adults to improve physical performance. Studies reviewed demonstrated improved physical performance with reductions in the TUG times and increased reps in the 30 sec sit-stand test demonstrating efficacy of BFRT in reducing fall risk and improving ADL's. It is imperative that thorough screening to ensure safety and appropriate use of device is conducted prior to BFRT, in the adult population. Blood flow restriction walking is a low-load alternative to resistance training for improving physical performance in older adults who are contraindicated to high-load resistance training.

PEDro Scores

Study	1	2	3	4	5	6	7	8	9	10	11	Total
Abe et al.	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6/10
Araujo et al.	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6/10
Clarkson et al.	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6/10
Karabulut et al.	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6/10
Ozaki et al.	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6/10

Title: The Impact of Home Health Care on Cost Effectiveness Compared to Other Post-Acute Settings in Individuals Status Post Total Joint Arthroplasty: A Systematic Review
Authors: Joe Pichiarello, Will Cavanaugh, Nick Mullery, John Huller
Purpose/Hypothesis: The purpose of this systemic review was to determine the cost effectiveness of home health care (HHC) compared to other post-acute care (PAC) settings in individuals status post total joint arthroplasty (TJA).
Materials/Methods: A literature search of Medline, CINAHL, PubMed, and Health Source: Nursing/Academic Edition was conducted using search terms: ("Total Joint Replacement" OR "Total Joint Arthroplasty" OR "Total Hip Replacement" OR "Total Hip Arthroplasty" OR "Total Knee Replacement" OR "Total Knee Arthroplasty") AND (Home-health* OR home health* OR home care OR home-based rehab* OR home intervention*) AND (Cost* Effect* OR Cost* OR cost-benefit* OR cost value analysis). Search limits: English, 2008-2018, human subjects, and peer-reviewed. Selection criteria: adults ($\geq$ 45 years old) who underwent a TJA, comparison of post-acute HHC to other PAC settings, and an outcome measure of cost effectiveness. Two reviewers independently assessed each study for methodological quality and came to a consensus based on MINORS guidelines.
Results: A total of 178 articles were screened for eligibility. Following detailed appraisals, a total of 7 studies met the selection criteria. MINORS scores ranged from 10-21 with a mean of 14.6. Sample sizes ranged from 50-468,075 (729,983 total). 2 of 7 studies included samples undergoing only THA, while 5 of 7 studies examined both THA and TKA. All studies compared HHC with inpatient rehab (IRF). 5 of 7 studies also included extended-care or skilled nursing facilities (SNF). Primary outcomes were economic evaluations of PAC. Across every study, HHC costs were lower than any other PAC. In the 3 of 4 studies that used statistical analysis, HHC was significantly lower than other PAC routes. PAC costs ranged from $4,000-$11,592 (HHC), $7,560-$14,544 (SNF), $7,135-$25,284 (IRF). Secondary outcomes ranged widely from functional outcomes (WOMAC and SF-36), patient satisfaction, length of stay (LOS), readmission rate (RR), and comorbidities. When analyzing cost effectiveness, 1 study found that it cost $627 (HHC) per Oxford Hip Score (OHS) gained, compared to $1,054 (IRF). No differences, between discharge routes, were found in WOMAC, OHS, SF-36 or patient satisfaction. LOS findings were inconsistent. 3 studies examined RR and 2 found that HHC was similar to SNF but significantly lower than IRF. 3 of 7 studies included patient comorbidities and found that patients discharged to IRF had significantly higher comorbidities compared to SNF or HHC.
Conclusions: There is moderate evidence suggesting that PAC discharge to HHC was consistently shown to be more cost effective than discharge to a SNF or IRF. Limitations included inconsistent sample characteristics, unclear protocols, and lack of long term follow up. Future research should aim at providing PAC discharge recommendations for middle age and older populations post total joint replacement.
Clinical Relevance: Based on the research, PTs should recommend a discharge to HHC after TJA compared to other PAC settings based on decreased costs and existing evidence in comparable functional outcomes.

Article Authors	MINORS Score	
Mahomed N et al[3]	21/24	Mean: 14.6/24 Range: 10/24 – 21/24
Sigurdsson E et al[4]	20/24	
Ramos NL et al[5]	14/24	
Sabeh KG et al[6]	13/24	
Ponnusamy KE et al[7]	13/24	
Bozic KJ et al[8]	11/24	
Slover JD et al[9]	10/24	

Title: The Effects of Intramuscular FES on Objective Gait Measures in Adult Patients with Chronic Stroke: A Systematic Review

Authors: Hakim, Renee M.; Haldeman, Levi; Jackowitz, Lisa; Oquendo, Aaron; Wells, Matthew L.

Purpose/Hypothesis: The purpose of this study was to determine the effectiveness of intramuscular functional electrical stimulation (IM-FES) for improving gait in adult patients with chronic stroke.

Materials/Methods: A literature search of PubMed, CINAHL, ProQuest, SAGE Journals, and Cochrane library was conducted using search terms: (implant* FES OR neuroprosthetic OR neuroprosthesis OR implant* stimulator) AND (lower leg OR lower extremity OR ankle) AND (gait OR ambulat* OR walk*) NOT microprocessor. Search limits included: human subjects, peer-reviewed, English language. Selection criteria: RCTs, adults (18 and older) with chronic (>6 months) stroke, use of IM-FES, and objective gait outcomes. Two reviewers independently assessed each study for methodological quality and came to consensus using PEDro guidelines.

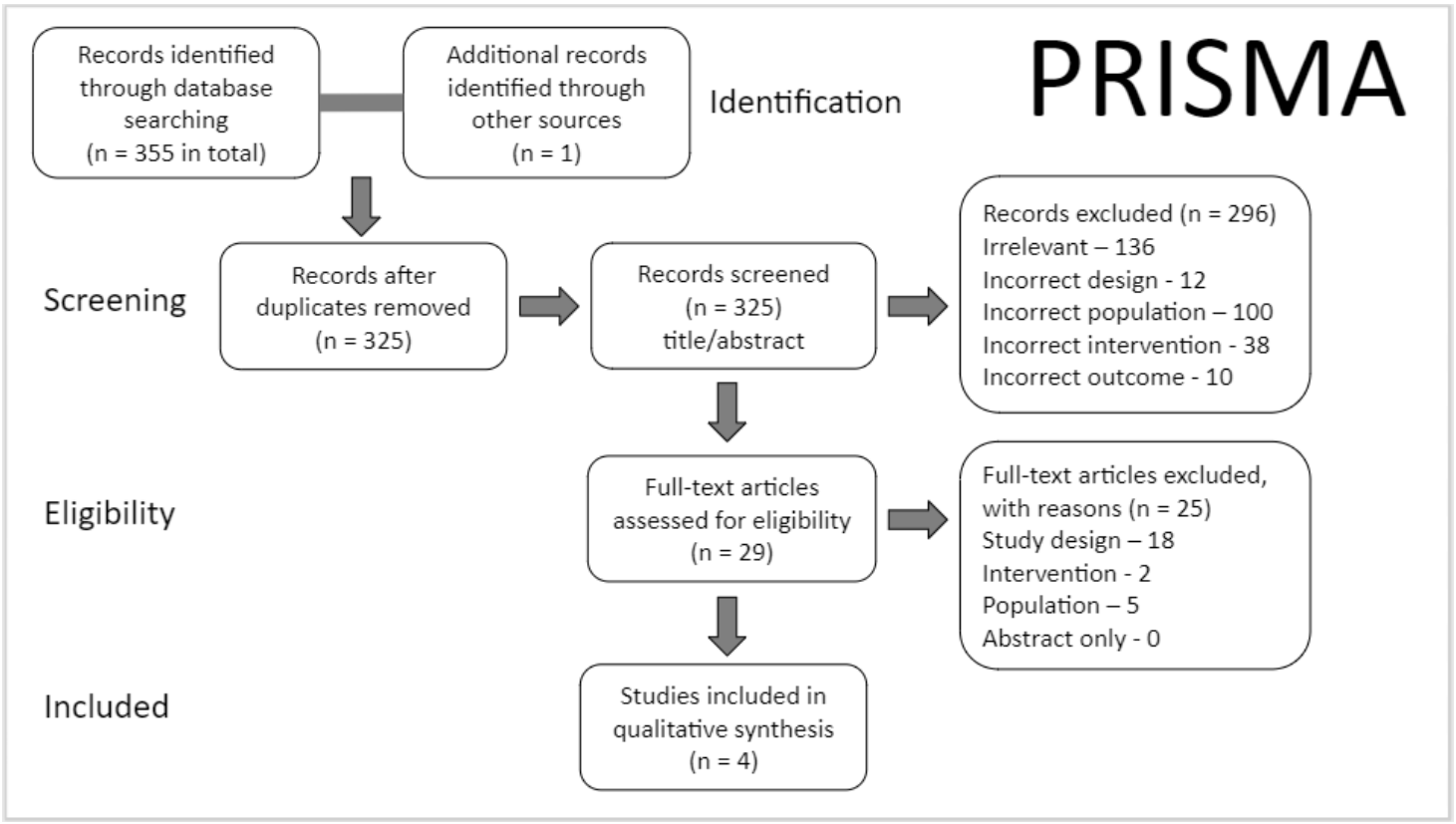
Results: A total of 356 articles were screened. After detailed appraisals, 4 RCTs met criteria. PEDro scores ranged from 5-7/10 (avg 6/10). Samples included a total of 124 adults with chronic stroke. Intervention groups received IM-FES on lower extremity muscles or peroneal nerves; control groups received no FES. Adverse effects of IM-FES included mild discomfort, erythema; no infections were reported. In 3 studies, BWSTT and gait training were used for all groups for 1.5 hrs, 4x/wk, 12 wks. 1 study compared IM-FES to conventional walking devices. Outcomes were assessed pre- and post-treatment, with follow-up at 6 months for 2 studies. IM-FES targeted pelvic stability, knee ext, ankle dorsiflexion (DF), knee flex, and knee ext during swing. All IM-FES groups had statistically significant improvements in gait outcomes compared to controls in areas of temporal-distance [Gait Assessment and Intervention Tool (G.A.I.T.), TG, OGA], kinematics (reduced stance and double support on paretic side, longer single support on non-paretic side, improved timing/range of DF during swing,) and self-reported functional mobility. Retention occurred 6 months after IM-FES removal in coordinated gait components, while controls worsened significantly at follow-up.

Conclusions: There is moderate evidence to support IM-FES for improving gait in patients with chronic stroke vs. BWSTT or gait training alone. Studies showed retention in gait kinematics 6 months post-treatment following removal of IM-FES. Limitations included small sample sizes, invasive surgery, co-interventions, and varied outcome measures and protocols. Future research should compare IM-FES to transdermal FES with gait training using standardized testing/training, including larger sample sizes and other populations.

Clinical Relevance: Clinicians should consider using IM-FES to promote greater retention of gait improvements vs. gait training alone in adults with chronic stroke. IM-FES resulted in normalized initial loading responses compared with a conventional walking device, which is likely to reduce stumbling in persons with drop foot. IM-FES is a safe and feasible intervention which may enhance carry-over and reduce falls following 12 weeks of intensive gait training.

PEDro Scale

Authors	Kottink et al. (2012)	Daly et. al (2004)	Daly et al. (2006)	Daly et al. (2011)
Random Allocation	Y	Y	Y	Y
Concealed Allocation	Y	N	Y	Y
Comparable at Baseline	Y	Y	Y	Y
Blinded Subjects	N	N	N	N
Blinded Therapists	N	N	N	N
Blinded Assessors	N	Y	Y	Y
Adequate Follow-Up	N	N	N	Y
Intention-to-Treat Analysis	N	Y	N	N
Between Group Comparisons	Y	Y	Y	Y
Point Estimates & Variability	Y	Y	Y	Y
Total	**5/10**	**6/10**	**6/10**	**7/10**



Title: The Effect of Transcranial Direct Current Stimulation on Balance and Mobility in Children with Cerebral Palsy: A Systematic Review

Authors: Courtney Jo James, Danielle Frank, Krista Ziegler, Sarah Kosik
Renée M Hakim, PT, PhD, Board-Certified Clinical Specialist in Neurologic Physical Therapy, Nicholas Rodio, PT, DPT

Purpose/Hypothesis: The purpose of this systematic review was to determine the effect of transcranial direct current stimulation (tDCS) on balance/mobility in children with cerebral palsy (CP).

Materials/Methods: A literature search of CINAHL, PubMed, Cochrane, ProQuest, ScienceDirect was conducted using search terms: Pediatric AND (cerebral palsy OR perinatal stroke OR stroke) AND (direct current stimulation OR current stimulation OR transcranial OR stimulation OR microcurrent). Search limits: English, human subjects, pediatric (0-18 years), peer-reviewed. Selection Criteria: Children with CP, interventions included tDCS, outcome measures of balance and/or mobility, study design limited to RCTs. Two reviewers independently assessed each study for methodological quality and came to a consensus based on PEDro guidelines.

Results: A total of 121 articles were screened for eligibility. Following detailed appraisals, 7 RCTs met criteria. PEDro scores ranged from 8 to 10 (avg=9.14). Samples ranged from 6 to 24 participants (126 total; age range 4-12) with CP (GMFCS Levels I-III). Treatment parameters included 1mA of anodal tDCS placed over primary motor cortex in 6 studies or cerebellum in 1 study. Five studies applied tDCS during treatment for five 20-minute sessions for 2 weeks, while 2 studies applied a single session of tDCS for 20 minutes. tDCS was combined with virtual reality (VR) in 4 studies and with treadmill training (TT) in 3 studies. Outcome measures included temporal-distance (gait analysis, 6MWT), kinematic analysis (Gait Profile Score), functional performance (GMFM-88, PEDI, TUG), and balance (sway, PBS). 6 of 7 studies had statistically significant improvements in balance and/or mobility with tDCS co-interventions (3 with VR and 3 with TT) as compared to usual care. 5 of 7 studies reported sustained improvements at 1 month follow-up. 6 of 7 studies found significantly greater improvements with anodal tDCS combined with VR (3 studies) or TT (3 studies) when compared to a control group with no adverse events reported.

Conclusions: There is strong evidence to support use of tDCS combined with VR or TT to improve balance/mobility in children with CP compared with usual care. Studies conducted over a 2-week period showed sustained performance of balance/mobility at 1 month follow-up. Both single session studies showed immediate improvements in gait and sway velocity for tDCS groups. Limitations included small sample sizes and wide range of motor levels (GMFCS I-III). Further research should focus on determining optimal training parameters of tDCS for this population to increase functional outcomes.

Clinical Relevance: All studies concluded that tDCS is a safe and feasible intervention for patients with varying types of CP, though not currently approved by the FDA in clinical settings. Multiple 20-minute sessions (10 sessions over 2 weeks) of 1mA anodal tDCS should be considered by clinicians as a potential treatment option in conjunction with balance/mobility training for children with CP as availability permits.

Article by Author	PEDro Score	Co-Intervention	Parameters	Key Findings
Grecco et. al.[2]	8	Virtual Reality	5x/week for 2 weeks (20 minute sessions)	• Significant improvements in cadence & velocity • Improvements in motor function based on the GMFM* • Significant improvements in mobility scores for the PEDI*
Duarte et al.[3]	10	Treadmill training		• Significant improvements in mobility scores for PEDI • Experimental group increased in PBS score after training * • Reduced body sway in AP/ML directions with eyes open and closed on a firm surface*
Grecco et al.[4]	9	Treadmill training		• Reduced sway in AP/ML directions with eyes open and closed on a firm surface*
Grecco et al.[5]	9	Treadmill training		• Significant improvements in cadence & velocity • Experimental group improvements in 6MWT
Lazzari et al.[6]	9	Virtual Reality		• Experimental group significant improvements in PBS* • Significant improvements in TUG*
Ferreira et al.[7]	9	Virtual Reality	Single 20-minute session	• Significant improvements in TUG
Lazzari et al.[8]	10	Virtual Reality		• Improvements in sway velocity in ML direction with eyes open and closed on foam surface • Improvements in sway velocity in AP/ML directions with eyes open and closed on firm surface

Significant = statistical significance ($p < 0.05$)
* = Improvements maintained at 1 month follow-up

Title: The Use of Cognitive Behavioral Therapy on Patients with Chronic Pain in Home Health Physical Therapy: A Systematic Review

Authors: McGowan, Maura; Collins, Tracey.

Purpose/Hypothesis: To examine the effectiveness and knowledge of using cognitive-behavioral therapy (CBT) for the management of chronic pain in home health physical therapy.

Materials/Methods: A literature search of CINAHL, Health Source, PubMED and ProQuest databases was conducted using search terms: “home health” or “home care” and “cognitive therapy” or “behavioral therapy” and “pain” or “pain management”. Search limited to: 2008 or newer, English and peer-reviewed. Selection criteria included adults with chronic pain receiving physical therapy services, or physical therapists who were treating patients with chronic pain in the home health setting. Articles were independently reviewed for methodological quality using the MINORS scale.

Results: A total of 241 articles were screened for eligibility. Following detailed appraisals, 4 studies met the selection criteria. MINORS scores ranged from 4/16 to 22/24 with an average score of 14. Sample sizes ranged from 16-588 subjects (808 total) with ages ranging from 55 to 92 years old. Studies included two telephone surveys to assess knowledge and use of CBT by PTs and two experimental studies to determine effectiveness and adherence. All studies included licensed PTs with knowledge of/experience in the home health setting. One study showed 80% of patients found success using CBT for better sleep, muscle relaxation and activity pacing to manage chronic pain. In that study, PTs felt comfortable delivering material after just 1 month of training. The most effective technique in 22/25 patients was deep breathing. In a similar study, 81% of PTs reported using activity pacing, while cognitive restructuring and visual imagery were only used by 12-16%. A total of 84% of PTs were interested in learning more about CBT to use in home health therapy. When compared to usual care, a 60-day assessment found significant improvements ($p<.0001$) in pain intensity, function and disability status when using CBT as an adjunct. However, a similar study found that CBT improved self-efficacy in exercise with chronic pain patients but did not significantly affect pain.

Conclusions: There is low to moderate evidence that CBT can be used in addition to regular treatment to manage chronic pain in the home health PT setting. PTs have a lot to learn about its use, and there is moderate evidence to show that it is of interest to them. The most effective CBT techniques for patient adherence are deep breathing and activity pacing. Further research should conduct more comparative studies with specific techniques in order to determine efficacy of CBT use in patients with chronic pain.

Clinical Relevance: The use of cognitive behavioral therapy in the home health setting to manage chronic pain can be an affective adjunctive therapy to traditional care. It requires little training and has many methods that can be added to treatment sessions taking up minimal time. There is no equipment involved, and it is easily administered in all settings with various patient diagnoses.

MINORS Scoring

Category	**Bach et al**	**Beissner et al**	**Carrington Reid et al**	**Cederbom et al**
Clearly stated aim	2	2	2	2
Inclusion of consecutive patients	2	0	2	2
Prospective collection of data	1	1	2	2
Endpoints appropriate to aim of study	2	0	2	1
Unbiased assessment of study endpoint	0	0	1	2
Follow-up period appropriate to aim	1	0	2	1
Loss to follow up less than 5%	1	1	1	1
Prospective calculation of study size	1	0	2	1
Additional criteria in comparative studies				
An adequate control group			2	2
Contemporary groups			2	2
Baseline equivalence of groups			2	2
Adequate statistical analysis			2	2
Total Score	**10/16**	**4/16**	**22/24**	**20/24**

Title: The Effect of Home Health Care in Reducing Hospital Readmissions: A Systematic Review

Authors: McGraw, Lindsay; Collins, Tracey

Purpose/Hypothesis: The purpose of this systematic review was to determine if home health care was effective in reducing hospital readmissions in adults.

Materials/Methods: A literature search (2008-2018) was conducted in CINAHL, HealthSource: Nursing/Academic Edition, PubMed, and ProQuest Central databases using search terms: (home care or home health) and (rehospitalization or readmission or hospital readmission) and (physical therapy or physiotherapy or rehabilitation) Search limits: English, peer-reviewed and humans. Selection criteria: adults over 18 y/o and primary outcomes of hospital readmission. One reviewer independently assessed each article for methodological quality using the MINOR's scale guidelines.

Results: A total of 365 articles were screened for eligibility. Following detailed appraisals, 5 studies met the selection criteria. MINOR scores ranged from 15/24 to 17/24 with an avg of 15.6. Sample size ranged from 68-1348 (2,940 total) with mean age of patients ≥65 y/o (range 18-100). Home care sessions ranged from 1-6 months. All five studies included multidisciplinary care that included physical therapy. Three of the five studies found a statistically significant decrease in hospital readmission (avg decrease of 51.4%). Two of the five studies targetted patients with CHF and found a statistically significant decrease (avg decrease of 46.6%). One study found that home care had a low rate of negative outcomes (6.7%).

Conclusions: There is moderate evidence to support home health care to reduce hospital readmission among patients ≥65 years old. Limitations included some studies having a small sample size and lack of explanation of interventions. Further research should include larger samples of patients with detailed explanations of treatment and consider varying diagnoses.

Clinical Relevance: Home health care should be considered by physicians in order to reduce hospital readmission. The most effective outcomes were found with treatment lasting 6 months, however similar results were found with home care lasting 1 month.

Minors Scale

Studies	Clearly stated aim	Inclusion of consecutive patients	Prospective collection of data	Endpoints appropriate to end of study	Unbiased assessment of study endpoint	Follow-up period appropriate to end of study	Loss to follow up less than 5%	Prospective calculation of the study size	Adequate control group	Contemporary groups	Baseline Equivalence of groups	Adequate statistical analyses	Total
Maliakkal AV, Sun AZ	2	2	2	1	2	1	2	2	0	0	0	2	16/24
Miller A, Edenfield EE, Roberto J, Erb JK	2	0	2	1	1	0	2	2	1	0	2	2	15/24
Tinetti ME, Charpentier P, Gottschalk M, Baker, DI	2	0	1	1	2	0	2	2	2	1	2	2	17/24
Watkins L, Hall C, Kring D	2	2	2	1	2	0	2	2	0	0	0	2	15/24
Bharadwaj S, Bruce D	2	2	2	1	2	2	2	2	0	0	0	0	15/24
Average Score													15.6

Authors: Gentile M, Lucke C, McSherry S, Ryan D, Schwartz J, Maida D
Title: The Effect of Equine-Related Therapy on Physical and Psychological Well-Being of Older Adults: A Systematic Review
Purpose/Hypothesis: The purpose of this systematic review was to determine the effect of equine-related therapy on the physical and psychological well-being of older adults (≥60 years).
Materials/Methods: A literature search of PubMed, CINAHL, ProQuest, and Cochrane Library was conducted using the search terms: (horse therapy OR equine therapy OR hippotherapy OR equine assisted therapy OR therapeutic riding OR simulat* riding) AND (older adults OR adults OR elderly OR geriatric*). Search limits: English, peer-reviewed, and published 2008-2018. Selection criteria: interventions including horse or horse simulated therapy, adults 60+, and physical or psychological outcomes. 2 reviewers independently assessed each study for methodologic quality and reached consensus using Sackett guidelines.
Results: 118 articles were screened for eligibility, yielding 10 studies after application of inclusion/exclusion criteria. Sample size ranged from 9-30 subjects (n=227) with age range 60-84 years. 7 studies excluded persons with known balance deficits. Sackett Levels ranged from IB-IV. Interventions included hippotherapy, equine-assisted therapy, therapeutic riding, and horse-simulated riding, varying in frequency and duration (1-5 days/week, 20-60 minutes, 8-12 weeks). Intervention facilitators included: physical therapist (PT) (3 studies), certified therapeutic riding instructor (2 studies) and unspecified (5 studies). Statistically significant improvements in physical outcome measures included: Timed Up and Go (2 studies), Berg Balance Scale (2 studies), Functional Reach (2 studies), Romberg (1 study), Fullerton Advanced Balance Scale (1 study), 10 Meter Walk (2 studies), gait parameters (1 study), and muscle activation (2 studies). Alpha wave power during EEG and the SF-36 were each used in 1 study to assess psychological well-being. Statistically significant improvement in overall perception of general health was noted via SF- 36 and fast alpha power. No adverse events were reported in 2 studies that specifically addressed safety.
Conclusions: Moderate to strong evidence exists supporting the use of equine-related interventions to improve physical well-being in older adults. These findings support improved balance, strength, and gait, thus increasing mobility and decreasing fall risk. Strong, but limited, evidence exists related to psychological well-being (improved restfulness and concentration). PTs were identified as key members of the therapeutic team. Limitations included exclusion of participants with known balance deficits, minimal assessment of psychological state, and diversity of study design, interventions and outcome measures. Future research should focus on addressing these limitations.
Clinical Relevance: Evidence supports the use of equine (live or simulated) interventions as safe and effective options for improving balance, mobility, strength, and well-being in community-dwelling older adults. Clinicians should consider integrating such interventions to combat the negative effects of aging when such resources are available.

Authors	**Study**	**Sackett Level**
de Araújo T, de Oliveira RJ, Martins WR, de Moura Pereira M, Copetti F, Safons MP (2013)[1]	Effects of hippotherapy on mobility, strength and balance in elderly	1B
Cho S (2017)[2]	Effects of horseback riding exercise on the relative alpha power spectrum in the elderly	1B
SeongGil K, Goon-Chang Y, Hwangbo G (2013)[3]	Effects of the horse riding simulator and ball exercises on balance of the elderly	2
Kim SG, Lee C-W (2014)[4]	The effects of hippotherapy on elderly persons' static balance and gait	2
Kim S, Lee J (2015)[5]	The effects of horse riding simulation exercise on muscle activation and limits of stability in the elderly	2
Kim S-K, Kim S-G, Hwangbo G (2017)[6]	The effect of horse-riding simulator exercise on the gait, muscle strength and muscle activation in elderly people with knee osteoarthritis	2
Araujo TB, Silva NA, Costa JN, Pereira MM, Safons MP (2011)[7]	Effect of equine-assisted therapy on the postural balance of the elderly	2
Homnick TD, Henning KM, Swain CV, Homnick DN (2015)[8]	The effect of therapeutic horseback riding on balance in community-dwelling older adults: a pilot study	2
Homnick DN, Henning KM, Swain CV, Homnick TD (2013)[9]	Effect of therapeutic horseback riding on balance community-dwelling older adults with balance deficits	4
Kim S-K, Hwangbo G (2017)[10]	The effects of horse-riding simulator exercise on balance in elderly with knee osteoarthritis	4

Local Resources:

- Hippotherapy
    - Equi-librium – *Nazareth, PA*; (610) 365 – 2266
    - Mane Stream - *Oldwick, NJ;* (908) 439 – 9636
    - Special Strides – *Monroe, NJ;* (732) 446 – 0945
- Therapeutic Riding
    - Oak Leaf Therapeutic Horsemanship Center - *Nicholson, PA;* 570-945-3922
    - Serendipity Therapeutic Riding Center - *Harveys Lake, PA;* 570-561-6743

Title: The Effects of Early Mobility in Reducing Length of Stay for Adult Patients in the Intensive Care Unit due to Trauma: A Systematic Review

Authors: Stephanie Klug SPT, Molly Loftus SPT, Stephanie Zaccaria SPT, Dana Maida PT, DPT GCS, Janette Scardillo PT, DPT, CBIS

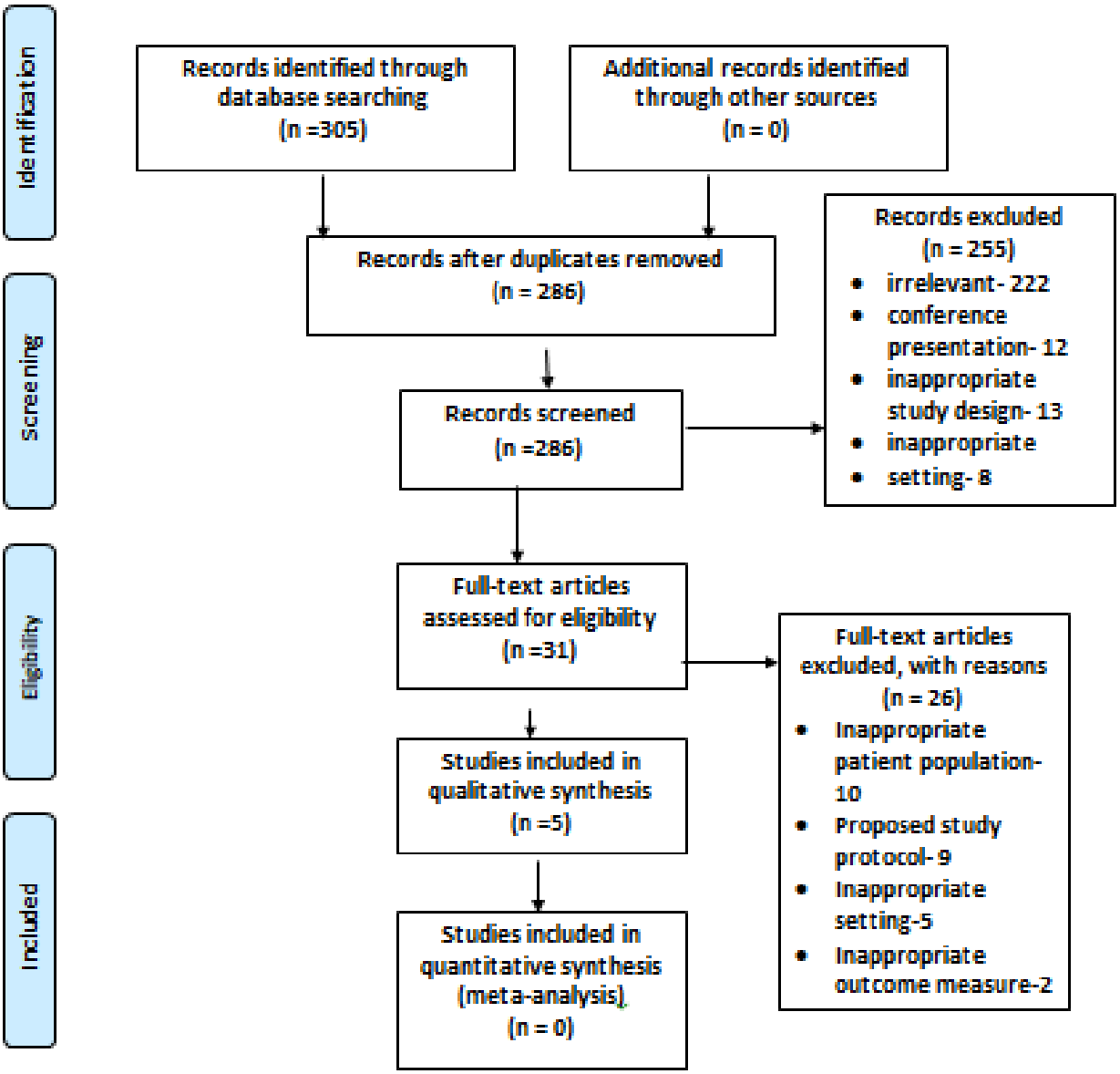
Purpose/Hypothesis: The purpose of this systematic review was to determine if early mobility is an effective intervention to reduce length of stay (LOS) for adults (≥18 years) in the intensive care unit (ICU) due to a traumatic event.

Materials/Methods: A literature search of ProQuest, CINAHL, Health Source and PubMed was conducted using search terms ("physical therapy" OR "physiotherapy") AND ("Intensive Care Unit" or "ICU") AND ("length of stay" OR "LOS") NOT ("pediatric" or "neonatal"). Search limits: English, peer reviewed, and published 2008-2018. Selection criteria: patients in ICU following traumatic event, adults 18+ years, mobility identified as an intervention, and reported hospital and ICU LOS. Two reviewers independently assessed each study for methodologic quality and reached a consensus based on Sackett guidelines.

Results: 305 articles were screened for eligibility, yielding 5 studies after application of inclusion/exclusion criteria. Sample size ranged from 30-2167 subjects (n= 2731). Sackett scores ranged from 3b to 4. All studies included patients following a traumatic event and some studies further specified ICU type: 2 neuro/trauma, 1 burn/trauma, 1 neurological, and 1 unspecified. None of the 5 articles clearly defined early mobility. 2 articles described a specific protocol to determine patient readiness for mobility. 2 articles implemented a specific treatment program as part of a quality improvement project. 3 articles retrospectively reported findings without changes to usual patient care. All 5 studies specified physical therapist involvement in the mobility program. Only 2 articles reported mechanism of injury and 4 articles reported specific patient diagnoses. 3 articles reported that early mobility is safe in a trauma population as evidenced by lack of adverse events. Severity of injury was identified in 4 studies via either the Injury Severity Scale or the Glasgow Coma Scale. Only 1 study reported statistically significant difference in hospital LOS and none reported significant differences for ICU LOS.

Conclusion: Weak to moderate evidence exists on early mobility for patients in the ICU following trauma. Although statistically insignificant, hospital and ICU LOS improved in all studies and physical therapists were identified as key members of the mobility team. Limitations included lack of rigorous study designs, small sample sizes, and lack of clearly defined terms, protocols, and mechanism and severity of injury. Future research should focus on addressing these limitations.

Clinical Relevance: Research on early mobility in the general ICU is present related to physiologic and functional benefits, however, limited quality research exists specifically related to the trauma population. All studies showed early mobility safely decreased LOS for patients in the ICU following trauma. Clinicians should consider use of more uniform protocols and outcome measures to improve evidence and quality of care in this area of practice.


Identification
Screening
Eligibility
Included
Records identified through database searching (n =305)
Additional records identified through other sources (n = 0)
Records after duplicates removed (n = 286)
Records excluded (n = 255)
irrelevant- 222
conference presentation- 12
inappropriate study design- 13
inappropriate
setting- 8
Records screened (n =286)
Full-text articles assessed for eligibility (n =31)
Full-text articles excluded, with reasons (n = 26)
Inappropriate patient population- 10
Proposed study protocol- 9
Inappropriate setting-5
Inappropriate outcome measure-2
Studies included in qualitative synthesis (n =5)
Studies included in quantitative synthesis (meta-analysis) (n = 0)

Title: How Graded Exercise Testing is Being Utilized in the Clinical Management of Individuals Following Concussion: A Systematic Review

Authors: Whelan, Kevin J.; Wilcox, William O.; Zajac, Alissa N.; Scardillo, Janette

Purpose/Hypothesis: The purpose of this study was to determine how graded exercise testing (GET) is being utilized in the clinical management of individuals following a concussion.

Materials/Methods: A literature search of PubMED, Google Scholar, CINHAL, and ProQuest was conducted using search terms ("concussion" OR "mild traumatic brain injury" OR "mTBI") AND ("Balke" OR "Buffalo" OR "graded exercise testing"). Search limits: English, human subjects, peer-reviewed. Selection criteria: individuals with concussion or post concussion syndrome, GET, and PT clinical management (defined as diagnosis, prognosis, return to play (RTP), and treatment planning). Three reviewers independently assessed each article for methodological quality and came to consensus using Sackett Level of Evidence.

Results: A total of 4,320 articles were screened for eligibility. 13 studies met the selection criteria. Sackett Levels ranged from 4 to 1b. All 13 articles included male and female participants (N=613; ages 10-72). Mechanism of injury varied, with sport related concussion in 10 articles, MVA/fall in 5, and 2 not specified. Time since injury was not clearly defined, however individuals with acute concussion were included in 5 articles and chronic concussion in 10. The Buffalo Concussion Treadmill Test (BCTT)/modified Balke Protocol was utilized in 10 articles. 5 used the BCTT as a diagnostic tool to assess exercise tolerance, 2 as a prognostic tool to predict recovery time, 7 for treatment planning to maintain subsymptom threshold during training, and 2 for RTP decision making. The McMaster All-out Progressive Continuous Cycle Test (MAPCCT) was used in 3 articles for prognosis and/or RTP decision making. One article also utilized a modified cycle ergometer protocol for diagnosis and treatment planning. All 13 articles assessed HR and used a symptom exacerbation scale as an objective measure. Additionally 4 used BP, and 7 used RPE to monitor patients during GET. Safety of GET in clinical management was assessed in 6 out of 13 articles with no noted adverse events.

Conclusion: Articles reviewed suggest that GET is utilized for multifactorial clinical management of concussion. GET may be safely implemented in the acute and chronic stages of concussion management. Limitations included a finite number of strong evidence studies with the developer of the BCTT as the primary author and/or contributor of the majority of articles reviewed, and a lack of standardization in the use of GET amongst researchers and clinicians. Further research is needed to assess how GET can be utilized as a standardized approach for clinical management of concussion.

Clinical Relevance: GET can be utilized to diagnose concussion subtypes, determine treatment at subsymptom threshold, predict recovery time, and guide return to play decision making in concussion management. Secondary to the majority of PT clinics possessing cycle ergometers and/or treadmills, the BCTT/modified Balke protocol and/or MAPCCT can be safely and feasibly utilized in clinical management of concussion in this patient population.

Article Citation	Study Design	Sackett Score
Cordingly et al.[3]	Retrospective chart review	4
Dematteo et al.[4]	Cross-sectional study	2b
Leddy JJ et al.[5]	Prospective randomized controlled trial	1b
Darling SR et al.[6]	Retrospective chart review	4
Kozlowski et al.[7]	Cross-sectional study	2b
Leddy et al.[8]	Prospective case series	4
Baily NF[9]	Case Report	4
Moore BM et al.[10]	Prospective Longitudinal Design	2c
Manikas et al.[11]	Pre-Post Prospective Design	4
Chrisman et al.[12]	Retrospective Cohort Study	4
Grabowski et al.[13]	Retrospective Cohort study	4
Gunter et al.[14]	Case Report	4
Anderson V et al.[15]	Case- Controlled Study	3b

Title: Effects of Combined Skilled Aquatic and Land Based Therapy Compared to Land Therapy Alone on Balance and Gait in Adults After a Stroke: A Systematic Review

Authors: Suchocki, Emily; Manzo, Megan; Vitolo, Gianna; Smith, Colleen; Leininger, Peter.

Purpose/Hypothesis: The purpose of this systematic review is to compare the effects of skilled aquatic therapy combined with land based therapy (AT/LBT) to land based therapy (LBT) on physical function in adults that have experienced a cerebrovascular accident CVA.

Materials/Methods: A literature search was done using MEDLINE/PubMed, CINAHL, ProQuest, Cochrane Library and hand-searching. Search terms included ("aquatic therapy" or "water therapy" or hydrotherapy or "water-based therapy" or "water exercise" or "aquatic exercise") AND ("cerebrovascular accident" or CVA or stroke). Search limits: peer-reviewed studies (2008-2018), English and human subjects. Selection criteria: adults at least 18 years old, following a CVA, no other neurological conditions, and therapy provided by a "skilled" or licensed PT or OT. Two reviewers independently assessed each article for methodological quality and came to a consensus using PEDro guidelines.

Results: A total of 352 articles were screened for eligibility and 5 articles met selection criteria. PEDro scores ranged from 5 to 7/10 (avg=6). The highest potential PEDro score was 8/10 as assessors and patients could not be blinded to aquatic therapy. Samples ranged from 20-120 participants (272 total). AT/LBT interventions varied from 5-7x/week (30-45 min) for 2-12 weeks. Primary outcomes assessed included static and dynamic balance using Berg Balance Scale (BBS), postural sway, and Functional Reach Test (FRT). Gait was also a primary outcome assessing cadence, speed, and 10 Minute Walk Test (10MWT). All studies with AT/LBT found greater improvements in outcome measures compared to the LBT. Three of 5 articles focused on gait. All 3 looked at different aspects of gait but found significant improvements in outcome measures including cadence, speed, and 10MWT. Three of 5 articles focused on balance. All 3 found significant improvements with AT/LBT compared to LBT, with the two articles utilizing BBS exceeding MDC values in AT/LBT and FRT scores exceeding MDC scores for AT/LBT. Outcome measures and protocols varied widely, but improvements were demonstrated in all studies.

Conclusions: Moderate to strong evidence supports both short and long term therapy combining aquatic and land based interventions on improving balance and gait in adults following a CVA. Limitations included widely varied protocols and outcome measures and inconsistencies in duration of CVA and interventions. Future RCTs should focus on longer durations of intervention with determination of the optimal mode and parameters for aquatic training.

Clinical Relevance: Clinicians should consider aquatic therapy with post-stroke patients to improve balance and gait. With clinically significant evidence of improved BBS and FRT scores, risk for falls will be decreased in this specific population. It is a safe intervention to improve aspects of mobility needed for community ambulation and activities. Evidence suggests AT/LBT, compared to LBT alone, better prepares patients with CVA for functional community participation and should be implemented into treatment.

PEDro Scores

Study	1	2	3	4	5	6	7	8	9	10	11	Total
Tripp et. al (2014)	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	7/10
Furnari et. al (2014)	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	6/10
Matsumoto et. al (2016)	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	7/10
Park et. al (2014)	Y	Y	N	Y	N	N	Y	Y	Y	Y	N	6/10
Han et. al (2013)	Y	N	N	Y	N	N	N	Y	Y	Y	N	4/10

Average: 6/10

Title: The Effect of Virtual Reality Training on Balance and Mobility in Adults with Moderate to Severe Traumatic Brain Injury: A Systematic Review

Authors: Christensen, Jamie; McGowan, Maura; McGraw, Lindsay; Piening, Cory; Hakim, Renee M.

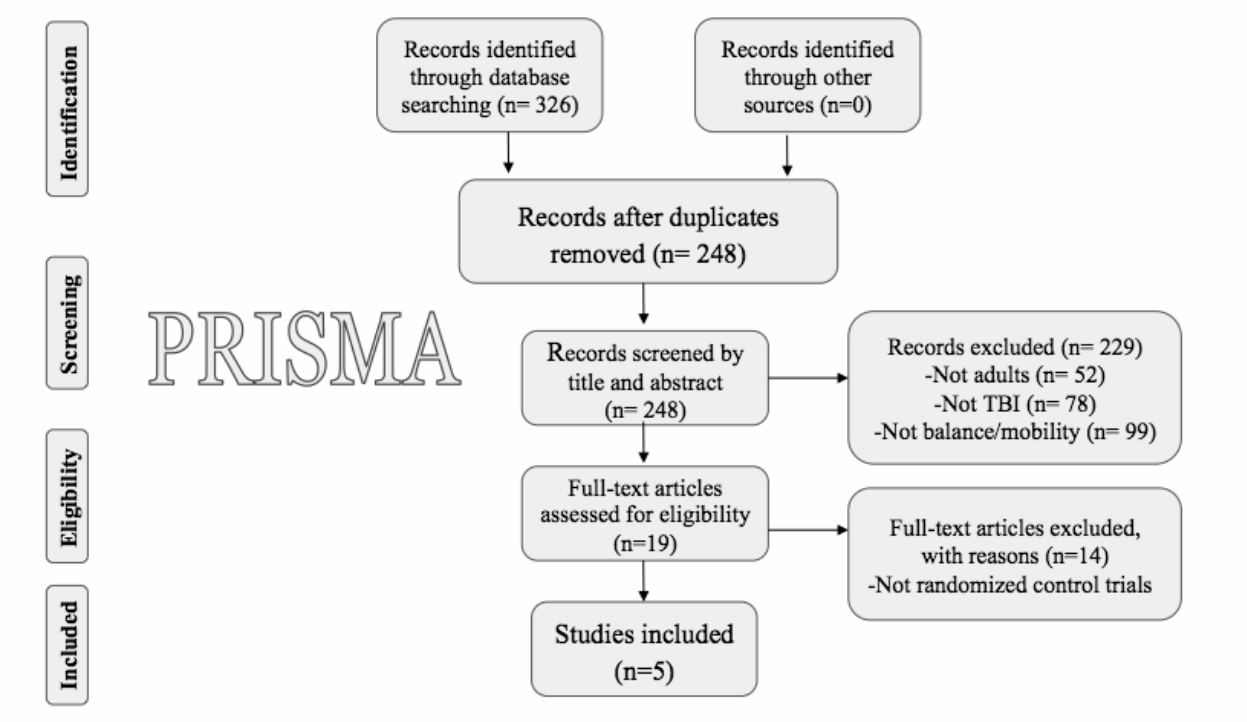
Purpose/Hypothesis: The purpose of this systematic review was to determine if virtual reality training was effective at improving balance and mobility scores in adults with moderate to severe traumatic brain injuries(TBI).

Materials/Methods: A literature search (2008-2018) was conducted in CINAHL, HealthSource: Nursing/Academic Edition, Medline/PubMed, and ProQuest Central databases using search terms: ("Brain Injury" OR "traumatic brain injury") AND ("virtual reality" OR gaming OR wii OR kinect) NOT concussion. Search limits: English, peer-reviewed and RCTs. Selection criteria included adults over 18 years old, moderate to severe TBI and primary outcomes of balance and mobility. Two reviewers independently assessed each article for methodological quality and came to a consensus using the PEDro guidelines.

Results: A total of 308 articles were screened for eligibility. Following detailed appraisals, 5 studies met the selection criteria. PEDro scores ranged from 6/10 to 9/10 with an average of 7.4. Sample size ranged from 11-26 subjects (105 total) with patients with TBI (aged 16-76 years). Treatments ranged from 12 to 20 sessions (15-60 min) over 4 to 6 weeks. Out of the five studies, one was completely immersive while the rest were non-immersive VR systems. Three of the five studies used commercially available equipment (i.e. the Wii and Xbox Kinect). All five studies found improvements in balance and mobility scores. Statistically significant improvements were found in TUG score (avg. change of 2sec), BBS (avg. change of 4.22 points), 30SST(avg. change of 1.44reps) and CB&M scores(avg. change of 8pts) across studies. Another study using the Wii showed non-significant improvements in BBS, FGA, 6-minute walk time and gait speed. All studies delivered therapy by licensed physical therapists in an inpatient or outpatient rehabilitation setting.

Conclusions: There is moderate to strong evidence that the use of VR can improve balance and mobility outcomes in patients with TBI when given as an adjunct to therapy with better results than usual care. The most clinically significant findings in balance and mobility measures (i.e CB&M, TUG exceeding MDIC) were found using eBaViR and WiiFit systems. Limitations included small sample size and varied use of outcome measures and protocols for balance and mobility. With studies including patients with acquired brain injuries from non-traumatic events, further research should include larger samples of patients with TBI and more uniform tests and measures to determine optimum VR protocols.

Clinical Relevance: Commercial VR systems (i.e. Wii and Xbox Kinect) are readily available to clinicians and should be considered as an adjunctive therapy in balance training in order to improve balance and mobility performance in patients with TBI. These systems are feasible and promote adherence and increased patient enjoyment. The most effective outcomes were found with sessions greater than 20 minutes over 6 weeks.



PEDro Scores

	Random Allocation	Concealed Allocation	Baseline Comparison	Blind Subjects	Blind Therapists	Blind Assessors	Adequate Follow Up	Intention to Treat	Between Group Comparison	Point Estimate Variability	Score
Straudi et al	Y	N	Y	N	N	N	Y	Y	Y	Y	**6/10**
Sessoms et al	Y	N	Y	N	N	N	Y	Y	Y	Y	**6/10**
Gil-Gomez et al	Y	N	Y	N	Y	Y	Y	Y	Y	Y	**8/10**
Cuthbert et al	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	**9/10**
McClanachan et al	Y	N	Y	N	Y	Y	Y	Y	Y	Y	**8/10**

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