Feasibility, Safety, and Functional Impact of Physical Therapy During Hemodialysis: a Systematic Review

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Background

- Prevalence of chronic kidney disease (CKD) among adult populations in the United States from 2011-2014 was 14.8%[1]
- Hospitalization of patients with end stage renal disease (ESRD) accounts for approximately 33% of total Medicare expenditures for patients on dialysis[1]
- Patients with ESRD are admitted to the hospital an average of twice a year[1]
- The average length of stay in the hospital for patients with ESRD in 2015 was 11.5 days[1]
- Among all patients on hemodialysis (HD) discharged from the hospital for any reason, 37.1% are re-hospitalized within 30 days[1]

Background cont.

- Benefits of exercise among patients receiving HD:
  - Improved aerobic capacity[2-4] and functional capacity[5]
  - Improved exercise tolerance[2] and physical fitness[6,7]
  - Improved systolic blood pressure[2,4,7]
  - Decreased muscle wasting[8,9]
  - Improved nutrition[7,10]
  - Improved lipid metabolism[4]
  - Improved control of diabetes[4]
  - Improved mental functioning[4,6,12,13]
  - Improved physical functioning[4,5,9,12-14]
  - Improved quality of life[4-7,9,10,12,13]
  - Decreased risk of cardiovascular related mortality[4,5,10,13]

Background cont.

- **Before Dialysis**
  - Uremic toxins[11]
  - Decreased brain perfusion[11]
  - Cognitive impairments:[11]
    - Dullness of intellect
    - Quiet stupor
    - Sluggishness of manner
    - Drowsiness
- **After Dialysis**
  - Cognition improves[11,13]
  - Physical fatigue[13]

Background cont.

- Traditional physical therapy guidelines state:
  - "Therapeutic exercise and airway clearance may be performed as indicated, but mobilization activities are relatively contraindicated during HD and the inflow or outflow of the dialysate during peritoneal dialysis (PD)"[15]
  - "Mobility treatments are contraindicated while a patient is undergoing any form of dialysis"[16]
- Lack of recent research support

Purpose

- Determine if physical therapy treatment during dialysis is safe, feasible, and effective
- Determine the impact of intradialytic physical therapy on functional mobility

Methods

Methods

Databases:

- Proquest Central
- Medline/Pubmed
- Cinahl Complete

Search Limitations:

- Human subjects
- English language
- 2006-2016
- Peer reviewed journals

Methods cont.

Search Terms:

- (physical therapy) AND ((during dialysis) OR (intradialytic)) AND ((physical performance) OR (mobility) OR ((walking) or (ambulation) or (gait)) OR ((fatigue) or (endurance)) OR (balance)) AND ((acute) OR (hospital) OR (inpatient) OR (outpatient))

Eligibility Criteria

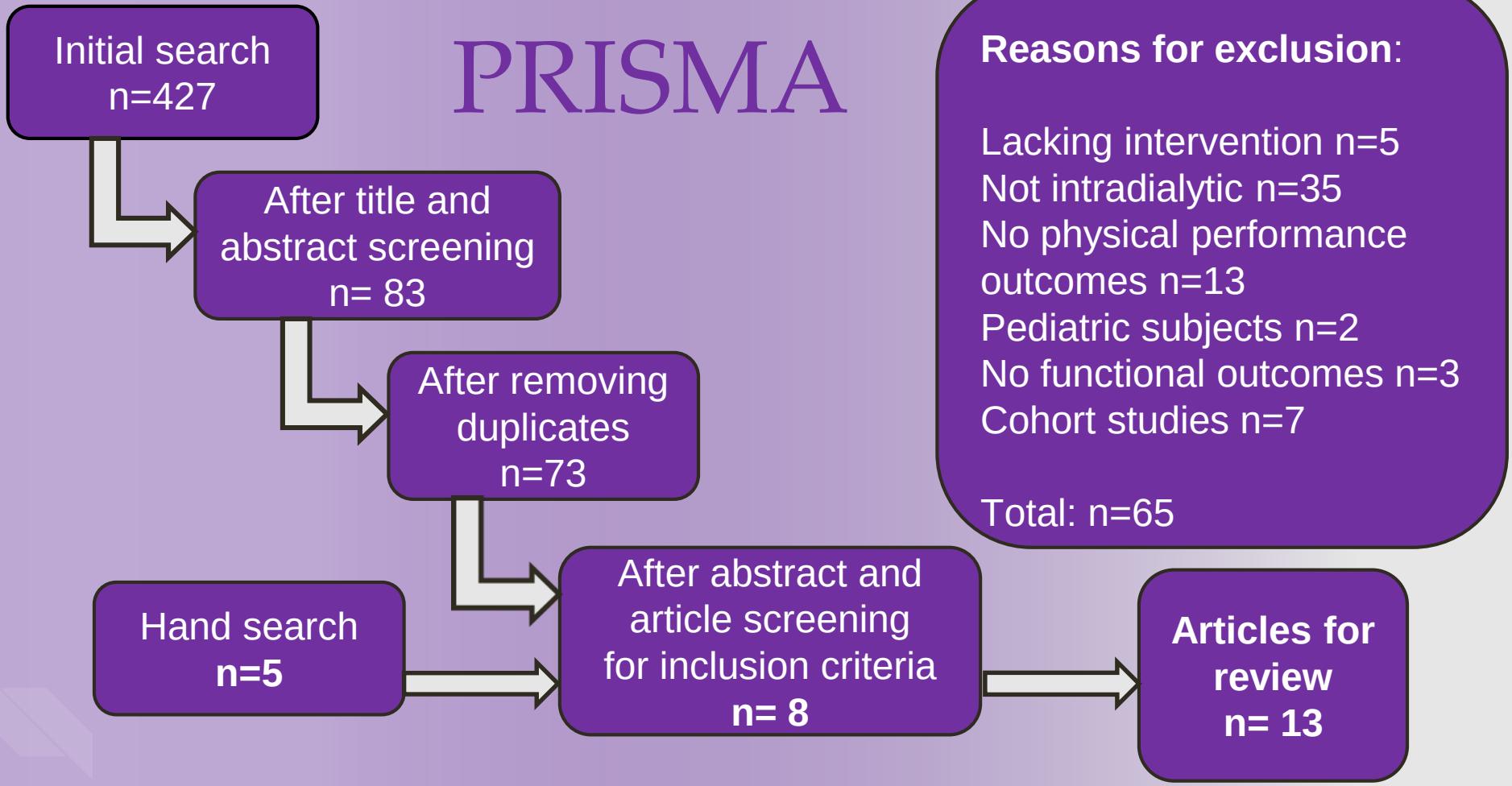
Inclusion Criteria:

- Intradialytic PT or intradialytic exercise
- Adults 18 years and older
- Functional performance outcome measures
- Randomized Control Trials or Quasi Experimental

Exclusion Criteria:

- Pre-dialysis protocols
- Post-dialysis protocols
- Patients younger than 18 years old
- Impairment level outcome measures only
- Cohort studies
- Case studies or case series

PRISMA


Initial search
n=427
After title and abstract screening
n= 83
After removing duplicates
n=73
Hand search
n=5
After abstract and article screening for inclusion criteria
n= 8
Articles for review
n= 13
Reasons for exclusion:
Lacking intervention n=5
Not intradialytic n=35
No physical performance outcomes n=13
Pediatric subjects n=2
No functional outcomes n=3
Cohort studies n=7
Total: n=65

MINORS Scale

Article	Score 1	Score 2	Average
Groussard et al[3]	20	20	20
Liao et al[5]	23	19	21
Bohm et al[6]	16	20	18
Orcy et al[7]	16	18	17
Cheema et al[8]	18	19	18.5
Chen et al[9]	17	21	19
Bulckaen et al[10]	14	18	16

MINORS Scale cont.

Article	Score 1	Score 2	Average
Segura-Orti et al[14]	21	20	20.5
Chang et al[17]	20	19	19.5
Dobsak et al[18]	20	20	20
Simo et al[19]	20	19	19.5
Simo et al[20]	18	20	19
Wilund et al[21]	18	22	20

Results

Results

- MINORS Average Score: 19/24
- MINORS Range: 16-21/24
- Sample sizes range from 18-71 (n=475)
- Outpatients with HD history of 3-48 months

Results cont.

Interventions:

- Upper extremity or lower extremity cycle ergometer (8 studies)[3,5-7,14,17,18,21]
- Resistance exercise (5 studies)[7-9,14,20]
- Walking (2 Studies)[6,10]
- Neuromuscular electrical stimulation (2 studies)[18,19]
- Combination of treatments (3 studies)[7,14,18]

Results cont.

Timing:

- Interventions lasted 30-60 minutes
- During first 1-2 hours (9 studies)[3,5-7,10,14,17,19,20]
- During hours 2-3 (2 studies)[9,18]
- Unspecified (2 studies)[8,21]

Results cont.

Intensity:

- RPE 7 (1 study)[10]
- RPE 12-15 (7 studies)[3,5-7,14,17,21]
- RPE 15-17 (1 study)[8]
- Not addressed (4 studies)[9,18-20]

Results cont.

Functional outcome measures used included:

- 6MWT (10 studies)[3,5-8,10,14,18-20]
- Variants of the sit to stand test (4 studies)[6,14,19,20]
- Incremental shuttle walk test (1 study)[21]
- Short physical performance battery (1 study)[9]
- Sit and reach (1 study)[6]
- Hemodialysis patient fatigue scale (1 study)[17]

Results cont.

- Of 475 total patients in the 13 studies, only 4 incidents were reported indirectly related to intervention
- 0.84% of patients experienced an event
- The 4 incidents:
  - 1 Rotator cuff tear[8]
  - 1 Musculoskeletal pain[17]
  - 1 Unsteady pedaling[17]
  - 1 RPE exceeded the experimental parameters[17]

Conclusion

Conclusion

- Moderate to strong evidence showing that outpatient PT during HD is **safe, feasible,** and **improves functional mobility**
- Significantly greater distance covered in 6MWT
- Decreased time to perform sit to stand variants
- Significant improvement in lower extremity function and flexibility
- Significantly improved exercise capacity on the treadmill
- Significantly increased physical activity in experimental groups

Clinical Relevance

- PT sessions are often missed in acute care due to HD treatments and subsequent fatigue
- Evidence supports the use of PT in the first 1-2 hours of HD in outpatient settings, without significant adverse events in patients with an established HD regimen
- Many of the reported interventions used in studies could be applied to the acute care setting

Limitations

- Lack of studies conducted in the acute setting
- Small sample sizes
- Varying protocols
- Various outcome measures
- Selection biases
- Lack of long term follow-up
- Studies conducted in foreign countries

Future Research

Future research should focus on the feasibility and safety of monitored PT during HD in **acute care**, using standardized interventions and outcome measures

Take Home Message

Clinicians should consider collaborating with a nephrologist to determine if a patient with an established HD program who is hemodynamically and medically stable would benefit from an intradialytic PT program on a case by case basis

Thank you!

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References

1. United States Renal Data System. 2017 USRDS annual data report: Epidemiology of kidney disease in the United States. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Disease. USRDS. Published 2017. Accessed 10/30/2017. https://www.usrds.org/2017/view/v1_06.aspx.
2. Goodman CC, Fuller KS. *Pathology: Implications for the Physical Therapist*. St. Louis, MO. Elsevier Saunders. 2015.
3. Groussard C, Rouchon-Isnard M, Coutard C, et al. Beneficial effects of an intradialytic cycling training program in patients with end-stage kidney disease. *Appl Physiol Nutr Metab.* 2015;40:1-7. doi:10.1139/apnm-2014-0357.
4. Musavian AS, Soleimani A, Alavi NM, Baseri A, Savari F. Comparing the effects of active and passive intradialytic pedaling exercises on dialysis efficacy, electrolytes, hemoglobin, hematocrit, blood pressure and health-related quality of life. *Nurs Midwifery Stud*. 2015;4(1):e25992. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4377533/pdf/nms-04-25922.pdf. Published January 15, 2015. Accessed November 1, 2017.
5. Liao M-T, Liu W-C, Lin W-C, et al. Intradialytic aerobic cycling exercise alleviates inflammation and improves endothelial progenitor cell count and bone density in hemodialysis patients. *Medicine*. 2016;95(27):1-9. http://dx.doi.org/10.1097/MD.0000000000004134.
6. Bohm C, Stewart K, Onyskie-Marcus J, Esliger D, Kriellaars D, Rigatto C. Effects of Intradialytic Cycling Compared With Pedometry on Physical Function In Chronic Outpatient Hemodialysis: a Prospective Randomized Trial. *Nephrol Dial Transplant.* 2014 Oct;29(10):1947-55. doi: 10.1093/ndt/gfu248.
7. Orcy RB, Dias PS, Seus TLC, Barcellos FC, Bohlke M. Combined Resistance and Aerobic Exercise is Better than Resistance Training Alone to Improve Functional Performance of Haemodialysis Patients - Results of a Randomized Controlled Trial. *Physiotherapy Research International*. 2012; doi: 10.102/pri.1526.

References

8. Cheema B, Abas H, Smith B, O'Sullivan A, Chan M, Patwardhan A, Kelly J, Gillin A, Pang G, Lloyd B, Singh MF. Progressive Exercise for Anabolism in Kidney Disease (PEAK): A Randomized, Controlled Trial of Resistance Training during Hemodialysis. *American Society of Nephrology*. 2007; 18:1594-1601. doi: 10.1681/ASN.2006121329.
9. Chen JLT, Godfrey S, Ng TT, et al. Effect of intra-dialytic, low-intensity strength training on functional capacity in adult haemodialysis patients: a randomized pilot trial. *Nephrol Dial Transplant*. 2010;25:1936-1943. doi:10.1093/ndt/gfp739.
10. Bulckaen M, Capitanni A, Lange S, Caciula A, Giuntoli F, Cupisti A. Implementation of Exercise Training Programs In A Hemodialysis Unit: Effects On Physical Performance. *JNephrol.* 2011;24(06):790-797. doi:10.5301/JN.2011.6386.
11. Nasser MET, Shawki S, Shahawy YE, Sany D. Assessment of cognitive dysfunction in kidney disease. Saudi J Kidney Dis Transpl. 2012;23(6):1208-1214. http://www.sjkdt.org/temp/SaudiJKidneyDisTranspl2361208-6280073_172640.pdf. Published November 17, 2012. Accessed Novemeber 1, 2017.
12. Henson A, Gillespie B, McCarthy A, et al. Intradialytic exercise: a feasibility study. *Ren Soc Aust J*. 2010;6(1):11-15. https://www.researchgate.net/profile/Carmel_Hawley/publication/45193008_Intradialytic_exercise_A_feasibility_study/links/0deec5199846a88c81000000.pdf. Published March 2010. Accessed November 1, 2017.
13. Delgado C, Johansen KL. Barriers to exercise participation among dialysis. *Nephrol Dial Transplant.* 2012;27:1152-1157. doi:10.1093/ndt/gfr404.
14. Segura-Orti E, Kouidi E, Lison JF. Effect of Resistance Exercise During Hemodialysis on Physical Function and Quality of Life: Randomzed Controlled Trial. *Clinical Nephrology*. 2009; 71: 527-537. doi: 10.5414/CNP71527.

References

15. Malone DJ, Lindsay KLB. *Physical Therapy in Acute Care: A Clinician's Guide*. Thorofare, NJ. SLACK Incorporated. 2006.
16. Paz JC, Panik M. *Acute Care Handbook for Physical Therapists*. Newton, MA. Butterworth-Heinemann Medical. 1997.
17. Chang Y, Cheng S-Y, Lin M, Gau F-Y, Chao Y-F. The effectiveness of intradialytic leg ergometry exercise for improving sedentary lifestyle and fatigue among patients with chronic kidney disease: a randomized clinical trial. *Int J Nurs Stud.* 2010;47(2010):1383-1388. doi:10.1016/j.ijnurstu.2010.05.002
18. Dobsak P, Homolka P, Svojanovsky J, et al. Intra-dialytic Electrostimulation of Leg Extensor May Improve Exercise Tolerance and Quality of Life in Hemodialysis Patients. *Artificial Organs*. 2011; 36: 71-120. doi: 10.1111/j.1525-1594.2011.01302.x
19. Simo VE, Jimenez AJ, Oliveira JC, et al. Efficacy of Neuromuscular Electrostimulation Intervention to Improve Physical Function in Haemodialysis Patients. *International Urology and Nephrology*. 2015; 47:1709-1717. doi: 10.1007/s11255-015-1072-3
20. Simo VE, Junque A, Fulquet M, et al. Complete Low-Intensity Endurance Training Programme in Haemodialysis Patients: Improving the Care of Renal Patients. *Nephron Clin Pract.* 2014;128:387-393. doi:10.1159/000369253.
21. Wilund KR, Tomayko EJ, Wu PT, et al. Intradialytic exercise training reduces oxidative stress and epicardial fat: a pilot study. Nephrol Dial Transplant. 2010;25:2695-2701. doi:10.1093/ndt/gfq106.


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