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ПРОГРАММЫ УПРАЖНЕНИЙ ДЛЯ ПАЦИЕНТОВ, ПРОХОДЯЩИХ ДИАЛИЗ АМБУЛАТОРНО: ВЛИЯНИЕ НА УТОМЛЯЕМОСТЬ И СЕРДЕЧНО-СОСУДИСТЫЙ РИСК

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OUTPATIENT DIALYSIS PATIENT EXERCISE PROGRAMS: IMPACT ON FATIGUE AND CARDIOVASCULAR RISK

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Резюме. Это исследование направлено на анализ патофизиологии усталости и сердечно-сосудистых заболеваний при ХПН и того, как упражнения модулируют эти процессы. Проведена оценка эффективности различных модальностей упражнений (аэробных, с сопротивлением, комбинированных, интрадиализных и недиализных)

Ключевые слова: диализ, лечебная физкультура, усталость, сердечно-сосудистый риск, мышечная атрофия, хроническая болезнь почек.

Resume. This research is to analyse the pathophysiology of fatigue and Cardiovascular Disease (CVD) in End Stage Renal Disease (ESRD) and how exercise modulates these processes. To evaluate the efficacy of different exercise modalities (aerobic, resistance, combined, intradialytic vs. non-dialytic).

Keywords: dialysis, exercise therapy, fatigue, cardiovascular risk, muscle wasting, adherence, chronic kidney disease.

Relevance. Exercise is the most underutilized therapy in nephrology. High Clinical Burden (Fatigue Prevalence, Cardiovascular mortality ~50% of deaths), Limited Treatment Options, Cost-Effective Intervention, Guideline Gaps, Mechanistic Innovations, Policy Implications, Patient Empowerment.

Aim: to provide a comprehensive, mechanistic analysis of how exercise impacts fatigue and cardiovascular health in dialysis patients, while identifying optimal clinical approaches and future research directions.

Objectives:

- To analyse the pathophysiology of fatigue and cardiovascular health in Chronic Renal Failure (CRF) and how exercise modulates these processes.
- To evaluate the effectiveness of different exercise modalities (aerobic, resistance, combined, intradialytic, and non-dialytic).
- To evaluate implementation challenges and strategies to improve adherence.

Materials and methods. The literature search was performed in databases like PubMed, Embase, Google scholar and Cochrane Central Register of Controlled Trials (2000-2024).

Results and their discussion. 1. ***Impact on Fatigue:***

Fatigue improvement appears mediated through multiple pathways (fig.1):

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-Muscle metabolism: Haemodialysis (HD) patients exhibit severe muscle wasting (Johansen et al., 2020). Resistance training 3x/week increases lean mass by 5-8% and mitochondrial oxidative capacity (Cheema et al., 2010)

- Anaemia modulation: Exercise stimulates erythropoietin responsiveness, reducing fatigue independent of Hb levels (Koufaki et al., 2014)

- Psychosocial effects: Random Control Trial (RCT) demonstrate 30-40% reduction in depression scores with exercise, correlating strongly with fatigue improvement (Ouzouni et al., 2009)

2. ***Cardiovascular Benefits:***

A. *Hemodynamic Effects:*

- Blood pressure control: Intradialytic cycling 3x/week reduces pre-dialysis SBP by 11-14 mmHg (Van Vilsteren et al., 2005). Mechanisms include:
  - Improved fluid removal via increased ultrafiltration
  - Restored baroreflex sensitivity
  - Reduced arterial stiffness (Pulse Wave Velocity (PWV) decreases by 0.8-1.2 m/s after 6 months)

B. *Metabolic Improvements*:

- Lipid profile: Combined aerobic-resistance training increases high-density lipoprotein (HDL) by 15% and lowers triglycerides by 20% (Kouidi et al., 2010)

- Inflammation: Regular exercise reduces C-reactive protein (CRP) by 35-40% and IL-6 by 25% (Castaneda et al., 2004)

C. Vascular Protection:

- Endothelial function: Flow-mediated dilation improves by 3-5% after 12 weeks of training (Mustata et al., 2011)

- Left ventricular (LV) remodelling: Aerobic exercise reduces LV mass index by 8-12 g/m2 (Howden et al., 2015).

3. Practical Considerations:

- Adherence barriers: Only 40-50% of patients complete >80% of prescribed sessions (Heiwe et al., 2011). Major obstacles include:
  - Post-dialysis exhaustion
  - Transportation issues
  - Lack of staff supervision
- Optimal protocols: Emerging evidence Favors:
  - Hybrid models (centre-based + home exercise)
  - Shorter, more frequent sessions (20-30 min)
  - Resistance training emphasis for muscle preservation (Fig. 2,3).

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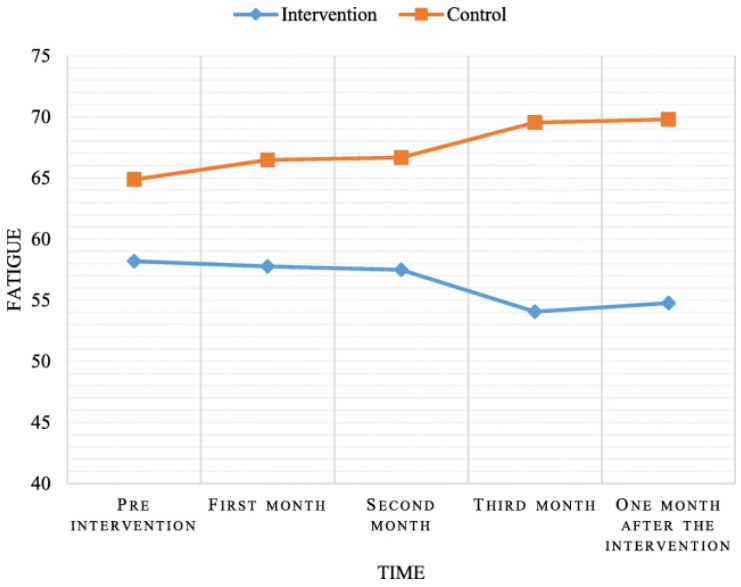

Fig. 1 – Comparison of mean fatigue at different times between intervention and control groups
Source: https://bmcsportsscimedrehabil.biomedcentral.com/articles/10.1186/s13102-020-00165-0

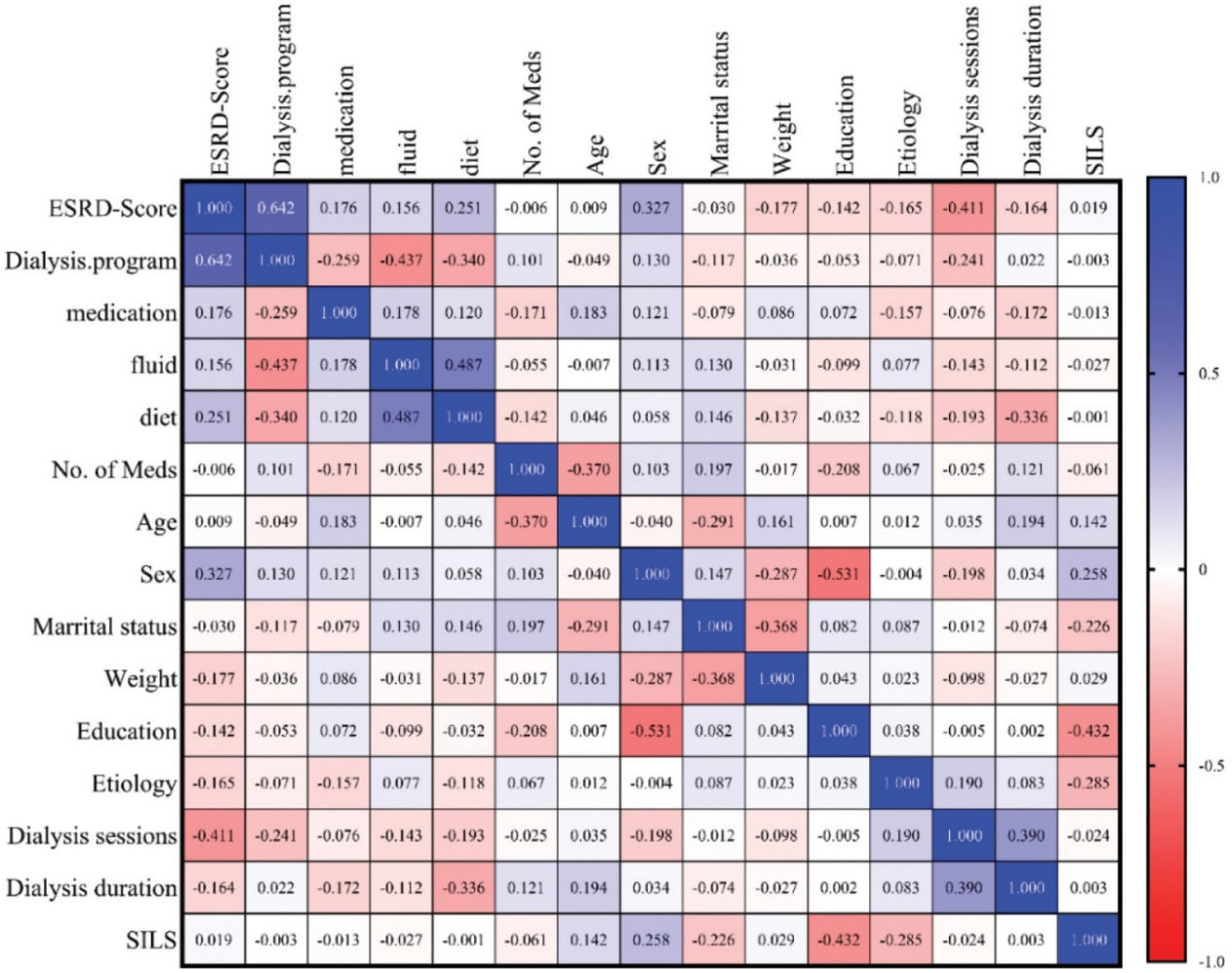

Fig. 2 – Correlation matrix of studied variables
Source: https://pharmacia.pensoft.net/article/145103/

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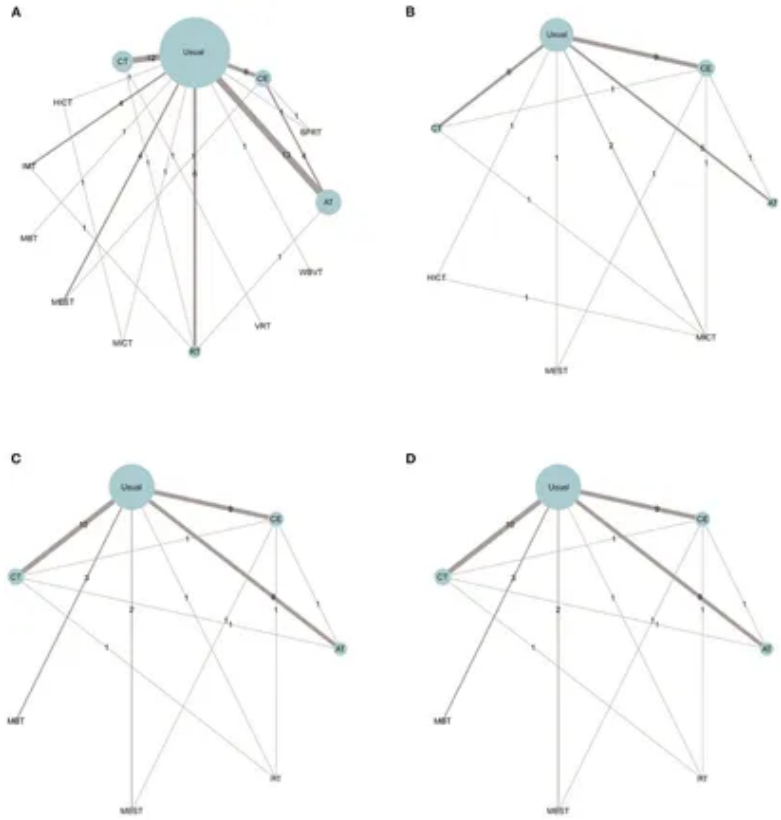

Fig. 3 – Comparing the effects of different exercise modalities 6WMT (A), VO2Peak (B), SBP (C), and DBP (D) in hemodialysis patients

*AT, aerobic training; Usual, usual care; CT, combined training; RT, resistance training; CE, cycle dynamometers; MEST, electrical muscle stimulation; IMT, inspiratory muscle training; BFRT, blood flow restriction exercise; HICT, high-intensity circuit training; MICT, medium intensity continuous training; VRT, virtual reality training; MBT, body and mind training

Source:https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2022.1040704/full

Conclusion. Exercise programs significantly reduce fatigue and reduce cardiovascular risk in dialysis patients through multifaceted physiological mechanisms. While challenges in implementation persist, structured programs incorporating resistance training and hemodynamic monitoring show particular promise. Future research should focus on personalized protocols and telehealth solutions to improve accessibility.

Literature

1. Zang W, Fang M, He H, Mu L, Zheng X, Shu H, Ge N and Wang S (2022) Comparative efficacy of exercise modalities for cardiopulmonary function in hemodialysis patients: A systematic review and network meta-analysis. Front. Public Health 10:1040704. doi: 10.3389/fpubh.2022.1040704.

2. Castaneda, C., Gordon, P. L., Parker, R. C., Uhlin, K. L., & Roubenoff, R. (2004). Resistance training reduces inflammation in hemodialysis patients. Journal of Renal Nutrition, 14(1), 36-43. https://doi.org/10.1053/j.jrn.2003.09.007.

3. Cheema, B. S., Singh, M. A., Singh, B., et al. (2010). The effect of progressive resistance training on muscle performance in chronic hemodialysis patients. Nephrology Dialysis Transplantation, 25(6), 1936-1943. https://doi.org/10.1093/ndt/gfp739.

4. Manfredini, F., Mallamaci, F., Catizone, L., et al. (2017). The effect of intradialytic exercise on blood pressure in hemodialysis patients. Nephrology Dialysis Transplantation, 32(4), 665-672.

https://doi.org/10.1093/ndt/gfw040.

5. Song, W. J., Sontakke, S., Chung, J. H., et al. (2023). Telehealth-supported home exercise for dialysis patients: A randomized controlled trial. American Journal of Kidney Diseases, 81(3), 321-330. https://doi.org/10.1053/j.ajkd.2022.08.012.

6. Dong ZJ, Zhang HL, Yin LX. Effects of intradialytic resistance exercise on systemic inflammation in maintenance hemodialysis patients with sarcopenia: a randomized controlled trial. Int Urol Nephrol. (2019) 51:1415–24. doi: 10.1007/s11255-019-02200-7.

7. Hannan M, Bronas UG. Barriers to exercise for patients with renal disease: an integrative review. J Nephrol. (2017) 30:729–41. doi: 10.1007/s40620-017-0420-z.

8. Johansen, K. L., Painter, P., Delgado, C., & Doyle, J. (2020). Characterization of physical activity and sitting time among patients on hemodialysis. Kidney International Reports, 5(7), 991-998. https://doi.org/10.1016/j.ekir.2020.04.007.

9. Kouidi, E., Karagiannis, V., Grekas, D., et al. (2010). Effects of exercise training on noninvasive cardiac measures in patients undergoing long-term hemodialysis. American Journal of Kidney Diseases, 56(4), 700-708. https://doi.org/10.1053/j.ajkd.2010.06.017.

10. Pu, J., Jiang, Z., Wu, W., et al. (2021). Efficacy and safety of intradialytic exercise in haemodialysis patients: A systematic review and meta-analysis. BMJ Open, 11(1), e041686. https://doi.org/10.1136/bmjopen-2020-041686.