Scientific Research Publishing

Open Journal of Applied Sciences, 2025, 15(12), 4014-4022
https://www.scirp.org/journal/ojapps
ISSN Online: 2165-3925
ISSN Print: 2165-3917

Advances in Exercise Management for Patients Undergoing Maintenance Hemodialysis

Xuebing Wu

Department of Internal Medicine, Jingzhou Hospital Affiliated to Yangtze University, Jingzhou, China
Email: 362027228@qq.com

How to cite this paper: Wu, X.B. (2025) Advances in Exercise Management for Patients Undergoing Maintenance Hemodialysis. *Open Journal of Applied Sciences*, **15**, 4014-4022.
https://doi.org/10.4236/ojapps.2025.1512259

Received: November 21, 2025
Accepted: December 19, 2025
Published: December 22, 2025

Abstract

End-stage renal disease is one of the leading causes of mortality among the population in China. Maintenance hemodialysis (MHD), as an optimal treatment for end-stage renal disease, has demonstrated clear efficacy and has been widely endorsed by patients. However, it is noteworthy that due to prolonged dialysis, these patients often have reduced physical activity, limited physical reserves, and impaired bodily functions, which predispose them to complications such as frailty and fatigue, severely affecting their quality of life. Exercise rehabilitation, as a long-term and effective intervention, has become the preferred option for improving the quality of life in MHD patients. This study synthesizes and reviews relevant literature concerning the current status of exercise among maintenance hemodialysis patients, influencing factors, and recent advances in exercise management for this population, with the aim of providing an important reference for the development of exercise management in MHD patients.

Keywords

Maintenance Hemodialysis, Exercise Management, Research Progress

1. Introduction

Chronic kidney disease is a common clinical condition with a high prevalence; data surveys indicate that the prevalence of chronic kidney disease among adults in China can reach 10.8% [1]. End-stage renal disease represents the final stage of chronic kidney disease and has become a serious public health issue in China, compromising individual health and increasing the burden on families and society. Maintenance hemodialysis (MHD) is one of the principal renal replacement therapies for end-stage renal disease. Through ultrafiltration, adsorption, and convection, it facilitates substance exchange, removes excess fluid from the body, preserves residual renal function, and prolongs patient survival. However, patients under-

going dialysis often experience poor quality of life, closely related to reduced physical endurance, fatigue, chronic low-grade inflammation, and calcium-phosphorus metabolic disorders. Therefore, strengthening exercise management for MHD patients holds significant clinical importance. In recent years, exercise management for MHD patients in China is still in its early stages. Considerable research has focused on exercise interventions to improve patients' microinflammatory status, fatigue, and physical endurance, but there is a lack of systematic summaries and analyses. Thus, building upon previous research, this study provides a review of advances in exercise management for maintenance hemodialysis patients, with the aim of exploring the prospects in the field of exercise rehabilitation for MHD patients.

2. Current Status of Physical Activity among Patients Undergoing Maintenance Hemodialysis

MHD is highly effective in treating end-stage renal disease, preserving residual renal function, and alleviating symptoms. However, due to its long treatment duration, MHD often leads to complications such as anemia, malnutrition, fatigue, and weakness, which can reduce physical capacity and negatively impact quality of life. Therefore, effective exercise rehabilitation management for MHD patients is of considerable importance. In 2020, Liang Xueming [2] and colleagues conducted a survey involving 120 MHD patients regarding their willingness to participate in exercise rehabilitation. The study found a generally high willingness among patients, although it was influenced by age (>60 years) and 6MWT distance (≤425 m). From 2020 to 2021, Mai Cuifang *et al.* [3] conducted a study on factors affecting the willingness to undertake exercise rehabilitation among 100 patients undergoing hemodialysis for uremia. The results showed that 22% of patients exhibited low willingness, which was associated with anemia, education level of junior high school or below, anxiety, lack of exercise rehabilitation health education, and higher FSS scores. Based on these findings, it is evident that multiple factors influence the exercise willingness of dialysis patients. Song Yan [4] examined the physical activity and exercise levels of hemodialysis patients from 2018 to 2019, revealing that 64.9% had low physical activity and 83.6% were physically inactive. Age, parathyroid hormone levels, and number of complications were negatively correlated with the physical activity index, while exercise level was negatively correlated with age and positively correlated with hemoglobin and creatinine levels. These results indicate that dialysis patients generally lack physical activity and have low exercise levels. Therefore, it is recommended to pay close attention to ESDR patients with the aforementioned risk factors.

3. Factors Affecting Exercise Participation in Hemodialysis Patients

3.1. Psychological Factors

3.1.1. Negative Emotions

ESDR assists in alleviating pathological symptoms in end-stage renal disease pa-

tients, preventing complications, slowing the progression of renal function loss, and extending survival time. However, long-term dialysis induces various degrees of physical symptoms (such as gastrointestinal reactions and fatigue), and in severe cases may result in anemia, heart failure, and other serious consequences, rendering exercise unfeasible. Additionally, changes in lifestyle, family roles, social relationships, and the uncertainty of prognosis contribute to severe psychological disorders in patients. Chen Rulan [5] and colleagues have noted that hemodialysis patients experience significant psychological distress and exhibit resistance to physical exercise.

3.1.2. Self-Efficacy

Self-efficacy refers to an individual's expectation of their ability to successfully perform activities. For MHD patients, prolonged bed rest and sedentary behavior result in reduced muscle activity, diminished skeletal muscle strength, and increased risk of disuse atrophy. Xiong Xiaohong [6] and others have noted that both the current state of physical activity and exercise self-efficacy among MHD patients remain at low levels. Wang Ying's [7] study of 265 patients revealed that refusals primarily driven by subjective factors were relatively frequent. Specifically, 57.8% of patients preferred quietness (or sleep) and did not wish to be disturbed, 24% rejected exercise, and 22.2% felt limited by their physical condition.

3.2. Low Educational Attainment and Limited Family Social Support

3.2.1. Low Educational Attainment

Behavioral intention generally refers to the strength of an individual's willingness to engage in a specific behavior. Perceptions of the benefits and barriers of exercise directly influence the willingness of dialysis patients to be physically active. In 2021, Xu Fengling *et al.* [8] conducted a survey involving 165 MHD patients to examine the factors influencing their "knowledge-attitude-practice" levels regarding exercise. The results showed that patients had low levels of "knowledge-attitude-practice" related to exercise, which was closely associated with lower educational attainment. The reason is that patients who have not received exercise rehabilitation health education lack a correct understanding of exercise rehabilitation concepts, making it difficult to recognize the importance and necessity of exercise rehabilitation. This impedes the development of healthy exercise mindsets and scientific, rational exercise habits, thus diminishing their willingness to participate in exercise rehabilitation. In addition, patients with education levels at junior high school or below have a limited understanding of the disease and fewer channels to acquire information about the disease and exercise rehabilitation, resulting in poor self-management behaviors.

3.2.2. Limited Family Social Support

Sun Liu's [9] study found that patients primarily spend their time during dialysis sleeping and watching TV. These behavioral factors are generated, on one hand,

under the cognitive system shaped by long-term medical, social, and family environmental backgrounds, and on the other hand, are also related to the timing and effectiveness of rehabilitation exercises conducted for MHD patients during dialysis. This includes family support and medical resources; the former is related to exercise behavior, as patients with high levels of social support are more likely to receive assistance and actively participate in regular physical activity. MHD patients, due to long-term dialysis, face heavier financial burdens on their families and gradually become detached from their previous lives. In addition, exercising outdoors increases the risk of injury, which leads to pronounced negative emotions.

3.3. Physiological Factors

3.3.1. Age

Zhu Yongguang [10] reported that 44.66% of maintenance hemodialysis patients exhibit reduced exercise capacity, which is associated with factors such as comorbid diabetes and nutritional support status. As age increases, physiological functions begin to decline, particularly those of the skeletal and muscular systems, making it difficult for the body to perform high-intensity exercise. Therefore, elderly hemodialysis patients are considered to have poorer exercise capacity.

3.3.2. Physiological Factors

Comorbidities and decreased metabolic capacity are important factors contributing to insufficient physical activity in hemodialysis patients.

4. Recent Advances in Exercise Management for Maintenance Hemodialysis Patients

4.1. Types and Intensity of Exercise

4.1.1. Traditional Exercise

This includes aerobic exercise, resistance exercise, and flexibility exercise. Among these, aerobic exercise involves physical activity performed with adequate oxygen supply, such as jogging, swimming, stair climbing, and cycling, typically for 0.5 hours per session, three times per week. Regular and moderate aerobic exercise can enhance dialysis efficacy, alleviate the body's stress response, and improve patients' microinflammatory states. It is noteworthy, however, that the anti-inflammatory benefits of aerobic exercise are less pronounced in elderly patients and those with a high burden of comorbidities.

Resistance exercise, also known as strength training, involves applying a certain amount of resistance during movement to promote muscle growth and increased strength. For MHD patients, resistance exercise can be categorized as exercises against one's own body weight (such as limb flexion, extension, and elevation) or against external resistance (using resistance devices such as resistance bands and dumbbells). It is generally recommended that MHD patients perform resistance exercise for 0.5 hours per session, with 10 - 15 movements per set, repeated for 3 - 5

sets, three times per week. Clinical practice has shown that resistance exercise effectively improves dialysis outcomes, accelerates blood circulation, promotes the elimination of metabolic waste, thereby reducing systemic inflammation and optimizing quality of life. Yan Xing *et al.* [11] conducted a study from 2020 to 2021 involving 94 MHD patients to assess the impact of progressive resistance exercise on physical ability, nutritional indicators, and sleep quality. The results showed that after the intervention, patients had improved handgrip strength, knee flexion strength, and 30-second loaded elbow flexion repetitions compared to pre-intervention values, with significant enhancements in sleep quality and nutritional status as well.

Flexibility exercises refer to practices, such as tai chi, yoga, and other gentle muscle stretching and slow-motion activities, that enhance patients' muscle flexibility and prevent muscle strains. For MHD patients, tai chi exerts varying degrees of pressure on patients' body tissues, accelerating the transport of intracellular solutes into the bloodstream, thereby improving dialysis efficiency, removing endotoxins and inflammatory factors, and alleviating the microinflammatory state. Zhang Yuanli *et al.* [12] conducted a study involving 30 patients with stage 5 chronic kidney disease undergoing MHD, in which traditional Chinese exercise guidance was provided. The results showed significant improvements in KT/V, URR, CRP, IL-1β, TNF-α, AST, and ALT after the intervention compared to baseline. Moreover, no adverse reactions such as skin itching, rash, palpitations, or abnormal blood pressure occurred during care. These findings suggest that exercise management based on traditional Chinese exercise theory may further enhance dialysis adequacy and improve the microinflammatory state in patients with stage 5 chronic kidney disease on MHD and is both safe and reliable.

4.1.2. Novel Motion

Whole-body vibration training is a passive training method that utilizes mechanical vibrations to stimulate the body, thereby inducing adaptive responses in the central nervous system during the phase. Since this form of training is not affected by the patient's own motor ability or health status, and due to its short intervention duration, it is suitable for MHD patients with low limb endurance. In recent years, whole-body vibration training has been widely applied in clinical practice due to its simplicity, safety, and reliability, and it has gained acceptance among patients undergoing rehabilitation for chronic diseases. It should be noted, however, that the use of whole-body vibration training has so far been limited to improving limb function and walking ability in MHD patients, while its effectiveness in alleviating their micro-inflammatory state remains unclear and requires further investigation.

With the rapid advancement of electronic information technology and internet technology in China, smart bracelets have demonstrated significant potential in the healthcare industry. By collecting real-time data on patients' heart rate, blood oxygen saturation, blood pressure, and other indicators, these devices can assist patients in adjusting the intensity and duration of physical exercise, thereby more

effectively supporting rehabilitation training and optimizing quality of life. Feng Lei [13] *et al.* conducted a study on 42 patients by integrating VR into home exercises for dialysis patients. The results demonstrated that this approach is beneficial for enhancing dialysis patients' confidence in self-regulated home exercises, increasing their motivation for regular physical activity, reducing the risk of falls, and thereby improving their quality of life. It holds certain clinical and practical significance.

4.2. Selection of Exercise Methods and Precautions

4.2.1. Selection of Exercise Methods

It is recommended that patients on dialysis begin exercise within the first 1 - 2 hours before dialysis to prevent muscle cramps and hypotension; however, there is a lack of robust supporting evidence. Moreover, factors such as the patient's condition, the spatial and medical resources of the dialysis unit, patients' individual dialysis preferences, and hemodynamic fluctuations can all affect the optimal timing for exercise during dialysis. Clinical practice indicates that patients with chronic kidney disease generally tolerate cycling exercises well during the first and second hours of dialysis, but most patients have to discontinue exercise due to hypotensive symptoms at the third hour. Therefore, the timing of exercise for hemodialysis patients should be determined by considering multiple factors to enhance exercise adherence. Seven studies [14]-[20] employed aerobic exercise methods, while five studies [21]-[25] utilized aerobic combined with resistance exercise methods. These exercise modalities are characterized by being simple, effective, and safe. Yuan Shuqi *et al.* [26] found that an exercise frequency of 3 - 5 times per week, with interventions lasting ≥ 12 weeks and each session lasting 30 - 40 minutes, yields relatively ideal effects in improving fatigue among MHD patients.

4.2.2. Precautions

The recommendations are as follows: 1) Blood pressure monitoring: for dialysis patients, maintaining systolic blood pressure between 140 and 160 mmHg is associated with the best prognosis. 2) Fluid volume: Guidelines for exercise in hemodialysis patients are very limited. However, the "Kidney Unit" guidelines abroad recommend that patients with interdialytic weight gain greater than 4 kg should not engage in intradialytic cycling or resistance exercise, as such activities may exacerbate increases in blood pressure and resting heart rate during dialysis in these patients. Therefore, it is recommended that in clinical practice, fluid volume should be reasonably controlled based on each patient's specific condition, symptoms and signs, and physiological parameters. 3) Vascular access: Resistance training plans for dialysis patients are relatively conservative. In the past, clinical recommendations advised that the limb with the vascular access should not be used to lift heavy objects, or should lift no more than 2.67 - 4.54 kg. Thus, it is advised that patients begin functional exercise on the third day after surgery, primarily with moderate-intensity training.

5. Conclusion

MHD plays a vital role in the treatment of end-stage renal disease. To ensure effective dialysis, guiding patients to adhere to appropriate and regular exercise can enhance physical endurance, reduce the state of micro-inflammation, and improve quality of life. This study reviews relevant literature and further analyzes the current exercise status and influencing factors among maintenance hemodialysis patients, concluding that the exercise status of MHD patients is currently unsatisfactory and is affected by physiological and psychological factors. Accordingly, both traditional and novel exercise modalities are adopted to achieve better dialysis outcomes and improve patient prognosis. At present, exercise management for MHD patients in China is still in an exploratory stage, particularly regarding the implementation and related reports on novel forms of exercise, with standardized exercise duration, intensity, and frequency still lacking; exercise programs lack unified management. Therefore, further research is needed to explore exercise management for MHD patients, with the aim of developing a practical exercise management program for MHD patients that incorporates internet technology to provide patients with more convenient and individualized exercise plans.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Jiang, S., Feng, M. and Huang, S. (2023) Effects of Different Ultrafiltration Volumes on Residual Renal Function in Hemodialysis Patients. *Journal of Shanxi Institute of Health Vocational and Technical Education*, **33**, 1-2. https://doi.org/10.26689/ur.v2i3.5500

[2] Liang, X. and Chen, Y. (2021) Analysis of Exercise Rehabilitation Willingness and Influencing Factors in Patients Undergoing Maintenance Hemodialysis. *Internal Medicine*, **16**, 530-532.

[3] Mai, C., Yan, B. and Liang, C. (2022) Logistic Regression Analysis of Factors Associated with Willingness for Exercise Rehabilitation in Dialysis Patients with Uremia. *Basic Medical Forum*, **26**, 108-110.

[4] Song, Y., Liu, H. and Zhan, M. (2023) Investigation and Analysis of Physical Activity and Exercise Status in Hemodialysis patients. *Journal of Nantong University* (*Medical Edition*), **43**, 327-331.

[5] Chen, R., Bi, X. and Wan, X. (2022) Survey on the Current Status of Psychological Distress in Hemodialysis Patients and Its Relationship with Rehabilitation Quality. *Chinese and Western Medicine Nursing* (*Chinese-English Edition*), **8**, 133-135.

[6] Xiong, X., Yuan, H., Yang, Y., *et al.* (2020) The Relationship between Exercise Status and Exercise Self-Efficacy in Maintenance Hemodialysis Patients. *Practical Journal of Clinical Medicine in Hospitals*, **17**, 53-56.

[7] Wang, Y., Gan, L., Ma, Y., *et al.* (2017) A Multicenter Survey on the Acceptance of Rehabilitation Exercise during Dialysis among Maintenance Hemodialysis Patients. *Chinese Journal of Blood Purification*, **16**, 798-802.

[8] Xu, F. and Liu, Y. (2022) Analysis of Influencing Factors on the "Knowledge-Belief-

Practice" Level of Exercise among Maintenance Hemodialysis Patients. *Clinical Medical Research and Practice*, **7**, 5-8.

[9] Sun, L., Wang, X., Li, L., *et al.* (2014) A Survey on the Stages of Exercise Behavior During Dialysis in Hemodialysis Patients. *Chinese Journal of Nursing*, **5**, 547-551. https://doi.org/10.1016/j.egypro.2014.11.1167

[10] Zhu, Y. (2020) Current Status of Exercise Capacity and Analysis of Influencing Factors in Maintenance Hemodialysis Patients. *General Practice Nursing*, **18**, 789-792.

[11] Yan, X., Zhao, Q. and Peng, Y. (2022) Effects of Progressive Resistance Exercise on Exercise Capacity, Nutritional Indicators, and Sleep Quality in Maintenance Hemodialysis Patients. *Evidence-Based Nursing*, **8**, 1215-1219.

[12] Zhang, Y., Liu, Y., Lin, Z., *et al.* (2022) Effects of Exercise Management Guided by Traditional Chinese Medicine Exercise Theory on Dialysis Adequacy and Micro-Inflammatory State in MHD Patients. *Chinese Journal of Gerontology*, **42**, 4210-4214.

[13] Feng, L., Li, Y., Yang, J., *et al.* (2021) Effects of Integrating Somatosensory Games Based on Virtual Reality Technology into Home Dialysis Exercise Management on Fall Risk and Quality of Life in Dialysis Patients. *Chinese Journal of Blood Purification*, **20**, 302-305+332.

[14] Zhang, H. (2020) The Effect of Rehabilitation Exercise Training on Sleep Quality and Fatigue Level in Uremic Hemodialysis Patients. *Health and Wellness Guide*, **43**, 285.

[15] Wang, X., Zhu, X., Xu, M., *et al.* (2015) Study on the Effects of Aerobic Exercise on Micro-Inflammatory State and Dialysis-Related Fatigue in End-Stage Renal Disease Hemodialysis Patients. *Traffic Medicine*, **29**, 360-362.

[16] Wang, T. and Liu, Y. (2020) Effects of Aerobic Exercise on Mineral Metabolism, Sleep Quality, and Fatigue in Maintenance Hemodialysis Patients. *Medical Information*, **33**, 77-79.

[17] Wang, H. (2017) Effects of Low-Intensity Aerobic Training Combined with Health Education on the Incidence of Complications and Quality of Life in Maintenance Hemodialysis Patients. *Nursing Practice and Research*, **14**, 31-33.

[18] Tao, H., Lu, Y. and Chen, Y. (2017) Effects of Low-Intensity Aerobic Rehabilitation Exercise on Lipid Metabolism, Dialysis Efficacy, and Dialysis-Related Fatigue in Hemodialysis Patients with Chronic Renal Insufficiency. *Shanxi Medical Journal*, **46**, 857-859.

[19] Jiao, Y. (2016) Intervention Effect of Aerobic Exercise on Fatigue Status in Maintenance Hemodialysis Patients. *Nursing Practice and Research*, **13**, 46-47.

[20] Guan, J. and Lai, S. (2019) Effects of Rehabilitation Exercise Training on Sleep Quality and Fatigue Level in Uremic Hemodialysis Patients. *Chinese Journal of Practical Nursing*, No. 26, 2012-2016.

[21] Zhang, C. (2021) The Effect of Rehabilitation Exercise on Sleep Quality and Fatigue Level in Patients with Chronic Renal Failure Undergoing Hemodialysis. *Reflexology and Rehabilitation Medicine*, **2**, 172-174.

[22] Xu, Y., Hu, Q., Zhu, X., *et al.* (2018) The Effect of Resistance Training Combined with Aerobic Exercise on Sleep Quality and Fatigue in Maintenance Hemodialysis Patients. *Nursing Research*, **32**, 17-319.

[23] Hao, D. (2019) Application of Resistance Training Combined with Aerobic Exercise in Hemodialysis Patients. *Nursing Practice and Research*, **16**, 66-67.

[24] Chang, P., He, K. and Li, H. (2020) The Effect of Resistance Training Combined with Aerobic Exercise on Fatigue and Quality of Life in Maintenance Hemodialysis Patients. *Medical Theory and Practice*, **33**, 1530-1532.

[25] Zou, Y. (2017) Study on the Effect of Resistance Training Combined with Aerobic Exercise on Sleep Quality and Dialysis-Related Fatigue in Maintenance Hemodialysis Patients. *Chinese Journal of Convalescent Medicine*, **26**, 13-16.

[26] Yuan, S., Wang, H., Qian, L., *et al.* (2021) Meta-Analysis of Exercise Intervention to Improve Fatigue in Patients with Systemic Lupus Erythematosus. *PLA Nursing Journal*, **38**, 20-24.