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Factors Influencing Discontinuation of Exercise Therapy During Hemodialysis

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ABSTRACT

Introduction: Various exercise therapy methods have been devised for dialysis patients. Nonetheless, even the best exercise regimen is ineffective if not sustained. This study aims to determine the dropout rate and factors influencing exercise therapy discontinuation during dialysis.

Materials and Methods: This observational, retrospective, and descriptive study included 31 people who underwent exercise therapy during hemodialysis sessions between April 2015 and March 2018 at a hospital. The mean age of the participants was 59.29±11.12 years (range 36–78 years), and the male/female ratio was 24/7. The participants were divided into two groups, the continuation group (15 patients who continued exercise) and the discontinuation group (16 patients who discontinued exercise). Data on physical function history (knee extension muscle strength, one-leg standing time (OLS), and 6-minute walking distance (6 MD)) were collected from medical records. All participants were interviewed using a questionnaire on factors involved in exercise discontinuation from April 2018 to March 2022.

Results: About half of the participants dropped out (51.6%). In particular, the results suggested that body pain was strongly associated with exercise discontinuation. In addition, 8 participants in the discontinuation group died during follow-up after exercise discontinuation (50%).

Conclusion: The study results suggest that it is essential to increase self-efficacy and satisfaction by devising exercise content that meets the individual's wishes to prevent dropouts during dialysis. In addition, measures against body pain are crucial to continue exercising. The relationship between exercise discontinuation during hemodialysis and mortality should be further examined.

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Introduction

Dialysis patients are increasing worldwide. According to the United States renal data system (USRDS), the prevalence of people on dialysis in 2019 compared to the population was the highest in Taiwan, followed by Japan, Thailand, Singapore, the United States, and South Korea, with Indonesia and Thailand showing large increases in prevalence over a decade from 2009 to 2019 [1]. In Japan, in addition to the increased dialysis patients, the aging of patients has become an issue. According to the Japanese Society for Dialysis Therapy (JSDT), the number of dialysis patients aged over 65 years was more than those aged under 64 years in 2017 [2]. As patients age, problems, such as sarcopenia or bone frailty increase, and exercise interventions are crucial.

Several reports indicated that people undergoing hemodialysis with sarcopenia have low survival rates [3, 4]. The prevalence rate of sarcopenia in people undergoing hemodialysis has also been reported to be 40%, and those with sarcopenia have significantly higher mortality than those without sarcopenia [5]. Exercise therapy for people undergoing hemodialysis is necessary to extend healthy life expectancy because sarcopenia and bone frailty are primary problems in older people worldwide and affect survival rates even in people undergoing hemodialysis. The exercise therapy during dialysis in people undergoing hemodialysis with sarcopenia for 12 weeks improved physical activity without significantly affecting muscle mass in a randomized controlled trial [6]. Furthermore, exercise therapy is essential to maintain physical function in renal rehabilitation. Clinical practice guidelines for renal rehabilitation in Japan suggest that exercise therapy is recommended for people receiving hemodialysis because it has been suggested to improve exercise tolerance, walking ability, and physical quality of life [7].

However, regardless of how good the exercise prescription is to hemodialysis patients, it has no value if it is discontinued. The patients undergoing hemodialysis are often bedridden and at rest during hemodialysis and are predisposed to decreased physical activity. Resting three times a week is equivalent to approximately 4 hours of hemodialysis per session. Therefore, people on dialysis should maintain and increase long-term physical activity because they have longer periods of physical inactivity than people not on dialysis. However, continuing exercise therapy for long periods is often difficult for many people undergoing hemodialysis. Although short-term rehabilitation interventions are possible for recovery from disease or injury, it is difficult to continue long-term exercise therapy. The people undergoing hemodialysis had a higher dropout rate (49%) from exercise than those with other chronic illnesses, such as Parkinson's disease [8]. Konstantinidou et al. [9] reported that people undergoing exercise therapy during dialysis thrice weekly had a lower dropout rate than those undergoing monitored exercise at a rehabilitation center. However, they reported a 17% dropout rate from exercise therapy during hemodialysis. Hence, measures to prevent people from dropping out of exercise therapy are necessary to maximize the effect of exercise therapy in people undergoing hemodialysis. Furthermore, it is necessary to analyze the factors preventing the continuation of exercise therapy during hemodialysis. However, few studies have been conducted on this topic, and the evidence for this is unclear.

Therefore, this study was conducted to determine the dropout rate and factors that led to the discontinuation of exercise therapy during hemodialysis. This study hypothesizes that hemodialysis patients who drop out of exercise do so for a variety of reasons, including the exercise content, the physical condition of the body at the time of exercise, and non-exercise conditions; this qualitative information will be used to examine the vital factors to continue the exercise.

Materials and Methods

Study design

The study design was a retrospective observational study using data from physical function history taken from medical records of previous physical measurements and results of previous interviews looking for factors related to exercise interruption on the factors related to involved in exercise discontinuation. From April 2018 to March 2022, all participants were interviewed using a questionnaire regarding the factors involved in exercise discontinuation.

Study participants and setting

The participants included 31 people (mean age: 59.29±11.12 years, 24 men and 7 women) who underwent exercise therapy during hemodialysis between April 2015 and March 2018 at the dialysis center of Mizuho Hospital in Ishikawa City, Japan. Those who had died by April 2022 were counted as deceased. Participants who received exercise therapy during dialysis were selected from approximately 300 people who underwent

Table 1. Results for physical function

Group	Variables	Mean±SD	
		Baseline	Post-exercise Data
Continuation	6 MD (m)	519.33±139.14	540.13±152.36
	OLS (s)	43.15±22.85	42.36±23.78
	Knee extension muscle strength (kgf.m)	9.73±4.19	9.68±4.66
Discontinuation	6 MD (m)	444.94±142.55	468.91±132.46
	OLS (s)	31.29±26.7	31.28±26.79
	Knee extension muscle strength (kgf.m)	8.97±5.80	9.34±5.63

6 MD: 6-minute walking distance test.

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outpatient dialysis during this period. Participants were selected via public recruitment through flyers and verbal publicity regarding the study content. Voluntary applicants were eligible for the study. The exercise therapy comprised supine ergometer exercise for 30 minutes during hemodialysis. This exercise used a variable-load supine ergometer (Terasu Ergo III™, Showa Denki Co., Ltd., Osaka, Japan). The exercise intensity was set from light to moderate at subjective exercise intensities. The participants were divided into two groups, those who continued exercise (15 participants in the continuation group, age 58±11 years, 13 men and 2 women) and those who stopped exercise (16 participants in the discontinuation group, age 60±11 years, 11 men and 5 women). The continuation group has been followed for a minimum of one year and a maximum of more than eight years, and some continuation records are still being updated. The dialysis initiation disease of the continuation group included two people with immunoglobulin A (IgA) nephropathy, seven with diabetic nephropathy (including nephrosclerosis complications), four with chronic glomerulonephritis, and two people with mesangial proliferative nephritis. The dialysis initiation disease of the discontinuation group included 4 people with diabetic nephropathy, 6 with chronic glomerulonephritis, 2 with immunoglobulin A (IgA) nephropathy, 1 with nephrosclerosis, 1 with polycystic kidney disease, 1 with lupus nephritis, and 1 with semilunar-forming nephritis. A wide variety of comorbidities were observed, and the number of comorbidities listed in the medical record did not differ significantly between the groups, averaging 5.27 (2–13) in the continuation group and 5.56 (2–8) in the discontinuation group.

Data collection

The physical function of this study's participants was measured every 3 months from the start of exercise therapy during dialysis. In addition, we extracted previously measured pre-exercise data (baseline data) and 3-month post-exercise data (post-exercise data) from medical records (Table 1). Physical functions included knee extension muscle strength, one-leg standing (OLS) time, and a 6-minute walking distance test (6MD). Knee extension muscle strength was measured using a handheld dynamometer (μ-TAS F1; Anima Corporation, Tokyo, Japan). It was measured in the sitting position, with a belt fixed at a 90° knee flexion angle and maximum isometric muscle strength. The measurement of muscle strength using handheld dynamometers has been reported to be highly reliable [10]. OLS was measured in the hospital rehabilitation room. Two measurements were taken twice with the patient self-reporting on which side he could stand more easily and the maximum holding time of up to one minute. OLS test can be a tool to predict frailty in community-dwelling elderly populations [11]. 6MD was measured in the hospital hallways, and the maximum walking distance recorded was 6 minutes. 6MD is useful as an integrated measure of mobility [12]. Each measurement was manualized and thoroughly practiced before implementation. In addition, people undergoing hemodialysis who discontinued exercise therapy during dialysis were interviewed about the reason for the interruption and related factors. Table 2 presents details of the interview items. The same questionnaire was administered to the continuation group after 3 months. Furthermore, the interviews were conducted face-to-face by a physical therapist during dialysis hours.

Table 2. Details of interview contents

No.	Items	Interview Contents
1	Good exercise opportunities	Did they feel that exercise therapy during dialysis was a good exercise opportunity?
2	Feeling the effect of exercise	Did you feel the benefits of exercise therapy during dialysis?
3	Dissatisfaction with the exercise content	Were you dissatisfied with the content of exercise therapy during dialysis?
4	Body pain	Do you feel pain in your daily life or during exercise?
5	Decreased physical function	Do you feel any decline in physical function in your daily life?
6	Inconvenience in daily living	Do you feel any inconvenience in your daily life?
7	Motivation for an exercise	Do you feel the need to exercise?
8	Presence or absence of job	Are you working?
9	Implementation of another exercise	Do you have opportunities to exercise other than exercise therapy during dialysis?

All answers were given as "yes" or "no".

Statistical analyses

The participants were divided into a discontinuation and continuation group. All physical function data are shown as Mean±SD for each group. The Wilcoxon signed-rank sum test was used to compare baseline and post-exercise physical function data. The Mann–Whitney U test was used to compare the physical function data of the discontinuation and continuation groups. We divided the participants in both groups into positive and negative opinions for each of the questionnaire items in Table 1 based on the survey results. Table 3 presents the ratio of people with these opinions. Cross-tabulation with the chi-square test was used to examine the relationship between two factors, continuation and discontinuation of exercise and positive or negative opinion for each item.

Similarly, it was also used to examine the relationship between exercise continuation and discontinuation and participants' survival and death. In addition, multiple logistic regression analysis was performed using continuation and discontinuation groups as dependent variables. The independent variables for multiple logistic analysis were the results of the questionnaire items that were correlated with the χ^2 test. All statistical analyses were performed using SPSS software, version 25 (IBM Corp., Armonk, NY, USA), and statistical significance was set at 5%.

Results

Approximately 16 of the 31 participants discontinued exercise therapy and the dropout rate was 51.6% (Figure 1). The reason for dropping out of school in 15 cases was the individual's wish, and in 1 case, the reason for the transfer was due to deterioration of condition. These 16 patients were considered the discontinuation group, and the remaining 15 patients were considered the continued exercise group, and their deaths were observed until April 2022.

Physical function was compared between the 15 participants in the continuation group and 16 in the discontinuation group. Table 1 presents the exercise function 3 months after the start. The 6MD and OLS time was higher in the continuation group than in the discontinuation group. In the pre- and post-intervention comparisons, an increased 6MD was observed after the intervention in both groups. However, no significant differences were observed in physical motor function between the continuation and discontinuation groups or between pre- and post-intervention comparisons.

Table 3 presents a cross-tabulation of the questionnaire results for each group. The chi-square test showed significant correlations between continuation/discontinuation of exercise and feeling the effect of exercise, dissatisfaction with exercise content, body pain, and inconvenience in daily living. The odds ratios for feeling the effect of exercise, body pain, and inconvenience in the daily living of the discontinuation group to the continuation group were significant at 13.125 (95% confidence interval [CI]), 1.364%, 126.305%), 28.167 (95% CI, 4.018%, 197.453%), and 6.500 (95% CI, 1.094%, 38.633%), respectively.

Table 3. Results of the chi-square test for questionnaire

Group	No.		P	Odds Ratio	95% CI
	Feel the Effect	Do not Feel the Effect			
Continuation	7	8	<0.05	13.125	1.364–126.305
Discontinuation	1	15			
Group	**Dissatisfaction With the Exercise Content**	**No Dissatisfaction With the Exercise Content**	**P**	**Odds Ratio**	**95% CI**
Continuation	0	15	<0.01	Could not be calculated due to the inclusion of 0	
Discontinuation	8	8			
Group	**Body Pain**	**No Body Pain**	**P**	**Odds Ratio**	**95% CI**
Continuation	2	13	<0.01	28.167	4.018–197.453
Discontinuation	13	3			
Group	**Decreased Physical Function**	**No Decreased Physical Function**	**P**	**Odds Ratio**	**95% CI**
Continuation	9	6	Insignificant	1.167	0.279–4.871
Discontinuation	9	7			
Group	**Inconvenience in Daily Living**	**No Inconvenience in Daily Living**	**P**	**Odds Ratio**	**95% CI**
Continuation	2	13	<0.05	6.500	1.094–38.633
Discontinuation	8	8			
Group	**Willingness to Exercise**	**Lack of Motivation to Exercise**	**P**	**Odds Ratio**	**95% CI**
Continuation	13	2	Insignificant	2.167	0.334–14.057
Discontinuation	12	4			
Group	**Having a Job**	**Worklessness**	**P**	**Odds Ratio**	**95% CI**
Continuation	7	8	Insignificant	1.125	0.273–4.635
Discontinuation	7	9			
Group	**Implementation of Another Exercise**	**Not Doing Another Exercise**	**P**	**Odds Ratio**	**95% CI**
Continuation	7	8	Insignificant	3.792	0.755–19.045
Discontinuation	3	13			

CI: Confidence interval.

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Table 4. The chi-square test for survival and death

Groups	No.		P	Odds Ratio	95% CI
	Death	Survival			
Continuation	1	14	<0.05	14.00	1.471–133.233
Discontinuation	8	8			

CI: Confidence interval.

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Table 5. Results of the multiple logistic regression analysis

Adopted Independent Variables	Partial Regression Coefficient	P	Odds Ratio	95% CI
Feeling the effect of exercise	2.897	0.059	18.128	0.900–365.024
Body pain	3.338	0.003	28.167	4.018–197.453

CI: Confidence interval.

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Note: Model chi-square test: P<0.01, Hosmer-Lemeshow test: P=0.906, Dependent variable: Continuation group=0, Discontinuation group=1. Independent variables not in the equation: Dissatisfaction with the exercise content and inconvenience in daily living.

Table 4 presents a cross-tabulation of exercise continuation and mortality risk. During the subsequent follow-up, 8 deaths were confirmed among the 16 participants in the discontinuation group. Of the 15 participants in the continuation group, only 1 death was confirmed. The chi-square test showed that these relationships were statistically significant. The odds ratio was 14.00 (95% CI, 1.471%, 133.233%), a significant risk factor.

Table 5 presents the results of the multiple logistic regression analysis with the binary data of the continuation and discontinuation groups as dependent variables. The independent variables entered were four nominal scales of "feeling the effect of exercise", "dissatisfaction with the exercise content", "body pain", and "inconvenience in daily living", which were associated with the χ^2 test. As a result, "feeling the effect of exercise" and "body pain" were incorporated into the regression equation. Of these, "body pain" was a significant variable, with an odds ratio of 34.656. The model χ^2 was significant, and the Hosmer and Lemeshow test results showed that the regression equation was compatible.

Discussion

This study was conducted to examine historical medical information data to determine the dropout rate of exercise therapy during hemodialysis and the factors contributing to this dropout rate. The results revealed a high dropout rate from exercise (51.6%) and identified various factors leading to exercise discontinuation.

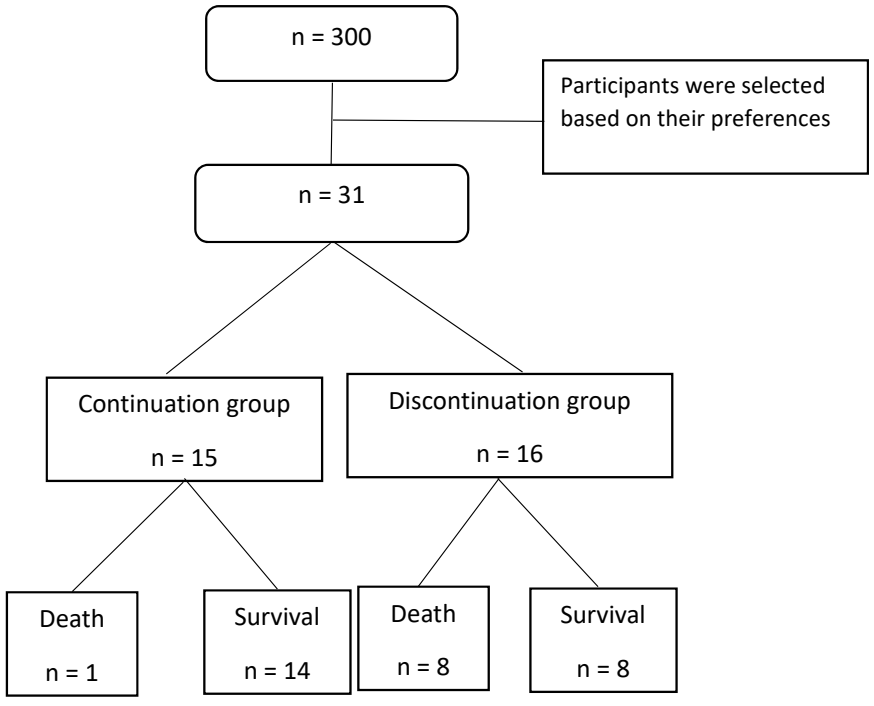

Figure 1. Participant tree

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Various studies showed that the dropout rate is high for exercise during dialysis, including a study with a 32% dropout rate [13] and another study reporting that more than half of the participants dropped out, even though they were children [14]. Although the dropout rate was high in the present study, it was confirmed to be a rare result in a long intervention period of several years. In addition, although the discontinuation group stopped exercise therapy at various times, only those who continued the intervention for 3 months were included in the study. Therefore, the data on whether physical activity can be maintained by continuing exercise after some exercise interventions would be valuable. These results suggest that exercise during dialysis is a good prescription to improve physical activity in people undergoing dialysis; however, continuing exercise for >3 months may result in higher dropout rates and lower physical activity.

This study showed a marked decline in physical function in the discontinuation group compared to the continuation group. In addition, Viken et al. cited low education, low grip strength, low cardiorespiratory fitness, and low physical activity levels as factors contributing to dropout from long-term exercise interventions among the older population [15]. Similar to the present study, poor physical function was often cited as a factor, suggesting that low physical function was the main cause of exercise discontinuation in this study.

The questionnaire results for both groups suggested that the discontinuation group was significantly less satisfied with the benefits of exercise, highly dissatisfied with the exercise content, experienced body pain, and felt more inconvenience in daily living than the continuation group. This study implemented the supine ergometer exercise as an intervention during dialysis. The exercise load was adjusted according to exercise capacity; however, the exercise resulted in high dissatisfaction levels in the discontinuation group. Luszczynska reported that in post-myocardial infarction rehabilitation, increased confidence (self-efficacy) in people who exercised and intended to resume exercise even after many breaks reduced the dropout risk [16].

Based on the results of this study, it is essential to increase self-efficacy and satisfaction by devising exercise content that meets the patient's wishes to prevent dropouts from exercise during dialysis. Furthermore, it is essential to apply positive feedback that enables people to feel the exercise content to enhance self-efficacy. Due to the search for further factors, the results showed that body pain was the most significant variable.

Although the questionnaire survey of this study did not examine the details of pain, the results suggest that checking for and responding to body pain is crucial to prevent patients from dropping out of exercise therapy during dialysis. In particular, body pain is a problem that cannot be addressed only by exercise during dialysis. Therefore, individualized rehabilitation interventions outside dialysis hours should be considered if these complaints are strong.

Subsequent follow-up in the continuation and discontinuation groups revealed that half of the people in the discontinuation group died. A significant correlation was found between the continuation or discontinuation of exercise and survival or death, with an odds ratio as high as 14.00. Although exercise discontinuation did not directly affect mortality, the results suggest that people who discontinued exercise had an extremely low subsequent survival rate. Previous systematic reviews have shown that physical activity reduces the mortality risk in people with end-stage renal failure [17]. This study only followed people for a short period, and it is unclear whether exercise discontinuation directly affected mortality. However, exercise cessation may have been associated with a potential physical problem that eventually led to death, and these relationships need to be further examined in the future.

This study had several limitations. First, the 3-month exercise intervention did not effectively improve physical function. Consequently, more effective exercise interventions in the future may make it possible to reduce dropout rates. Second, the number of study participants was small. Hence, it is necessary to increase the number of participants in the future to confirm the present study's results. However, despite these limitations, this study can determine the specific factors leading to exercise discontinuation and subsequent outcomes of people who discontinued exercising. Therefore, it is necessary to educate people on the associated mortality risk from exercise discontinuation and take measures that can prevent the factors that lead to exercise discontinuation to reduce exercise discontinuation in the future.

Implications for clinical practice

The results of this study suggest that people who drop out of exercise therapy do not realize its benefits and are often dissatisfied with the exercise content. In addition, high levels of body pain and lifestyle inconvenience may occur. Hence, preventing these factors in advance may play an essential role in continuing exercise. The number of deaths reported during subsequent follow-ups

was higher among those who discontinued exercise than among those who did not. Further validation of the relationship between reduced physical activity and risk of death after exercise discontinuation is needed.

Conclusion

This study showed a high dropout rate from exercise therapy during hemodialysis. Factors associated with exercise discontinuation included feeling the effect of exercise, dissatisfaction with exercise content, body pain, and inconvenience in daily living. Hence, preventing these factors in advance is likely critical for the continuation of exercise. In addition, the exercise discontinuation group had a higher mortality rate in the subsequent course. The relationship between exercise discontinuation during hemodialysis and mortality needs further examination.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethics Committee of Mizuho Medical Corporation (Code: 23). The requirement for the acquisition of informed consent from the participants was waived due to the retrospective nature of this study.

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Authors' contributions

Conceptualization and Supervision: Masahiro Noguchi and Yoshitaka Koshino; Methodology: Masahiro Noguchi and Miho Tanaka; Investigation, Writing – original draft, and Writing – review & editing: All authors; Data collection: Miho Tanaka and Masahiro Noguchi; Data analysis: Masahiro Noguchi.

Conflict of interest

The authors declared no conflict of interest.

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