



Short report

Physical function of outpatients and inpatients on dialysis who received physical therapy: an exploratory, cross-sectional study by JSPTDM

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ABSTRACT

Objective: Hospitalization for conditions including cardiovascular diseases, infections, orthopedic diseases, and cerebrovascular diseases is responsible for the decline in activities of daily living (ADLs) in patients on dialysis. Rehabilitation during hospitalization helps these patients recover their physical function, resume ADL, and ultimately resume regular outpatient dialysis. However, the actual physical condition of patients on dialysis who are prescribed and require physical therapy has not been reported. Hence, we elucidated the actual physical condition of outpatients and inpatients on dialysis who were prescribed physical therapy.

Methods: This retrospective, multicenter, cross-sectional survey included dialysis patients who received hemodialysis or hemodiafiltration and underwent physical therapy. We investigated the following physical functions: knee extensor strength, grip strength, and short physical performance battery. The number of patients with physical function below the reference values was also examined. Moreover, we investigated the patients' demographic data and blood biochemistry tests. Descriptive statistics were used to analyze the survey items. Comparisons were conducted using the chi-squared and Mann-Whitney U tests.

Results: Altogether, 116 patients were included in the analysis; 90 were outpatients and 26 were inpatients. Analysis of the demographic data revealed that the inpatients had a significantly higher percentage of concomitant cardiovascular disease, lower extremity arterial disease, and diabetic neuropathy than the outpatients. The percentage of patients whose results were lower than the reference values for knee extender strength, grip strength, and SPPB was greater than 80% in the inpatients and approximately 50% in the outpatients.

Conclusion: More than half of the dialysis patients in this study had a poor functional status, which was defined as equivalent levels of frailty and sarcopenia. The physical function of inpatients was particularly low.

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INTRODUCTION

Physical therapy for hemodialysis patients has significance not only as a means of improving the physical function of patients with disability and thus improving activities of daily living (ADLs) and quality of life (QOL), but also as a means of disease management to improve life prognosis by maintaining physical activity and physical function of outpatient maintenance hemodialysis patients with preserved physical function. Recently, the mean age of patients at the start of dialysis treatment is approximately 70 years and, when categorized in 5-year increments, the most common ages are 75-79 years for men and 80-84 years for women¹. A statistical survey by The Japanese Society for Dialysis Therapy reported that half of the elderly patients on dialysis aged ≥ 75 years required occasional minor assistance¹ due to their poor exercise habits. A majority (60%-80%) of the population in all age groups had “little or no” exercise habits. Moreover, the percentage of the population with “little or no” exercise habits increased as the age increased¹. Lack of exercise and low levels of physical activity are risk factors for the acceleration of frailty and sarcopenia, especially in elderly patients on dialysis. Therefore, physical therapy is essential to prevent severe deterioration of physical function. Moreover, the hospitalization of outpatients on dialysis is the leading cause of a decline in ADL in these patients. The major reasons for hospitalization include cardiovascular diseases, infections, orthopedic diseases, and cerebrovascular diseases², which tend to lead to a decline in physical function and ADL. Physical therapy during hospitalization has an essential role in the improvement of physical function, recovery of ADL, and resumption of regular outpatient dialysis. Previous studies of stabilized patients on regular outpatient dialysis in Japan have investigated physical functions, such as muscle strength^{3,4}, physical activity levels^{5,6}, and prognosis^{3,5-7}. However, status of decline in physical function of patients who are prescribed and require physical therapy by physicians has not been reported. In addition, it is necessary to clarify whether inpatients have reduced physical functions compared to outpatients.

Therefore, the purpose of this study was to elucidate the status of decline in physical function of outpatients and inpatients on dialysis who were prescribed physical therapy.

METHODS

1) Study design and setting

In this exploratory cross-sectional study, five Japanese general hospitals with inpatient beds that received a request to cooperate by the Japanese Society of Physical Therapy for Diabetes Mellitus participated. The data were collected after obtaining approval from the Institutional Review Board of the Japan Society of Physical Therapy (Approval number: H29-006). The data collected at each participating hospital were anonymized and were not consolidated. In addition, written informed consent was obtained from the participants in this study. The period of data collection was from January 2017 to January 2019, and we retrospectively researched the medical records of patients who were prescribed physical therapy by their physicians during that period.

2) Patients and data collection

Outpatients and inpatients who received hemodialysis or hemodialysis filtration therapy for end-stage chronic kidney disease and underwent physical therapy as prescribed by physicians were included in this study. Patients with cognitive impairment who had difficulty understanding the purpose of the study or the content of the evaluation were excluded from the study.

We investigated the following physical functions: knee extensor strength, grip strength, and short physical performance battery (SPPB). The number of patients with physical function below the reference values was also examined. Moreover, we investigated the patients' demographic data, which included age, sex, body mass index (BMI), duration of dialysis, main reason for inpatient hospitalization, concurrent conditions (hypertension, dyslipidemia, cardiovascular disease, cerebrovascular disease, lower extremity arterial disease [LEAD], diabetes mellitus, diabetic retinopathy, and diabetic neuropathy), and blood biochemistry tests, including serum hemoglobin (Hb), serum albumin (Alb), serum calcium (Ca), serum phosphorus (P), and the standardized dialysis dose of urea (Kt/V).

3) Methods for assessing physical function

Grip strength was measured with a Smedley type hand dynamometer (101A HATAS, Hata Sporting Goods Ind. Ltd.,

Osaka, Japan)⁸. The ratio of knee extensor strength against body weight (kgf/kg) was recorded^{8,9}. Knee extensor strength was measured with a device used for measuring isometric knee extensor strength (μ -tas, MF-01, Anima Inc., Tokyo, Japan). The SPPB consists of the following three sub-items: the standing balance, gait, and chair stand tests. Each item is scored from 0 to 4 points, with a total score ranging from 0 to 12 points¹⁰. The reference values for decreased physical function was set at 26 kg for males and 18 kg for females with grip strength, 0.4 kgf/kg for knee extension, and 9 points for SPPB^{11,12}. In all patients, muscle strength and physical performance were measured using the same method by physical therapist at each facility on a non-dialysis day.

4) Statistical analysis

We calculated the descriptive statistic values of the survey items from all the outpatients and inpatients. Subsequently, the data obtained from three outpatients and inpatients on dialysis were compared using the chi-squared and Mann-Whitney U tests. Statistical analysis was performed with SPSS Statistics Version 25 for Mac (IBM, Tokyo, Japan) with the significance level set at 5%. Missing values for knee extensor strength and grip strength were addressed with listwise deletion. We compared patient attributes before and after the deletion of missing data to reduce selection bias.

RESULTS

A total of 143 patients were selected for inclusion during the study period. Twenty-seven patients were excluded due to missing knee extensor strength and grip strength assessment results. As a result, 116 patients were included in the analysis; 90 were outpatients and 26 were inpatients (Figure 1). Analysis of the demographic data revealed that the inpatients had a significantly higher percentage of concomitant cardiovascular disease, LEAD, and diabetic neuropathy than the outpatients. In addition, Hb and Alb in the inpatients were lower than those in the outpatients (Table 1). In eligible patients treated with physical therapy, median knee extensor strength was 0.41 and kgf/kg in outpatients and inpatients, respectively, the median grip strength was 22.5 and 15.5 kg, respectively, and the median SPPB was 11 and 3 points, respectively. The percentage of

patients with results below the reference values for knee extensor strength, grip strength, and SPPB was >80% for inpatients and approximately 50%-60% for outpatients (Table 2).

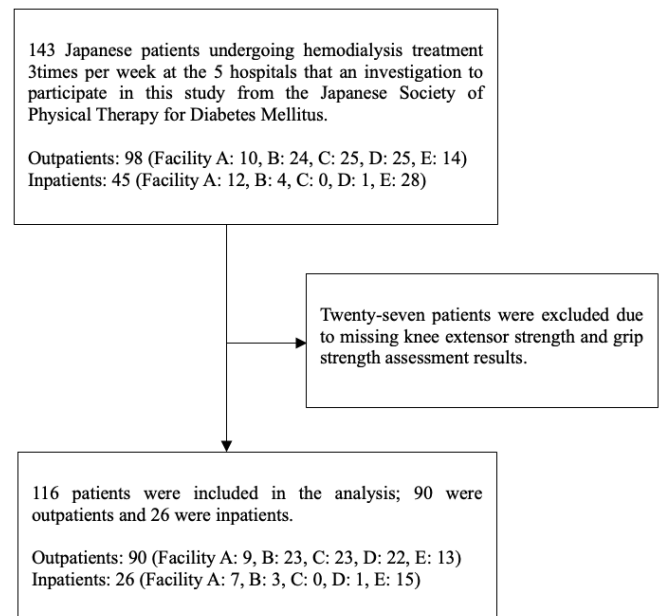


Figure 1. Flow diagram of patient selection and exclusion process.

DISCUSSION

In this multicenter study, 116 dialysis patients from five facilities were analyzed to investigate the physical function of patients who underwent physical therapy. The results showed that most of the patients who required physical therapy had significantly reduced physical function and physical performance. A previous systematic review reported that frail patients on dialysis had a higher mortality rate than non-frail patients¹³. Therefore, rehabilitation including exercise therapy is considered necessary to improve sarcopenia, given the poor prognosis of patients whose physical function is reduced and who require physical therapy, such as the subjects in this study. In the present study, the proportion of outpatients on dialysis with reduced physical function was 48%- 60%, and this was even higher in inpatients (>80%), suggesting a higher incidence of frailty, when compared to previous studies reported in a systematic review¹⁴. However, in this previous study, the proportion of dialysis patients with frailty was reported to range

Table 1. Demographic data and biochemical findings of the patients

N	All patients (n=116)	Outpatients (n=90)	Inpatients (n=26)	P value
Age (years)	70 (62-76)	69 (63-74)	73 (61-80)	0.12
Sex (sample) male/female	70 (60)/46 (40)	54 (60)/36 (40)	16 (61)/10 (39)	0.88
BMI (kg/m ²)	20.7 (18.0-23.4)	20.9 (17.9-23.9)	19.8 (18.0-22.3)	0.29
Dialysis duration (years)	7.5 (3-14)	7.0 (3-13)	9.5 (1-20)	0.55
Main reason for hospitalization of inpatients (%)				
Cardiovascular disease			23	
Cerebrovascular disease			24	
Orthopedic			31	
LEAD			4	
Others			18	
Concurrent conditions (%)				
Hypertension	89	88	92	0.52
Dyslipidemia	47	44	54	0.40
Cardiovascular disease	56	49	81	0.00
Cerebrovascular disease	21	18	31	0.15
LEAD	28	23	46	0.02
Diabetes mellitus	54	54	54	0.96
Diabetic retinopathy	24	24	23	0.88
Diabetic neuropathy	28	21	42	0.01
Serum Hb (g/dL)	10.6 (9.83-11.3)	10.9 (10.1-11.5)	9.70 (9.05-11.2)	0.00
Serum Alb (g/dL)	3.60 (3.30-3.80)	3.60 (3.40-3.80)	3.35 (2.80-3.63)	0.00
Serum Ca (mg/dL)	8.60 (8.20-9.18)	8.65 (8.30-9.13)	8.60 (8.05-9.23)	0.92
Serum P (mg/dL)	5.10 (4.13-5.80)	5.15 (4.20-5.90)	4.85 (3.63-5.63)	0.13
Kt/V	1.56 (1.34-1.78)	1.55 (1.33-1.78)	1.58 (1.37-1.88)	0.87

The data are shown in the median values (25th-75th percentile).

BMI, body mass index; LEAD, lower extremity artery disease; Hb, hemoglobin; Alb, albumin; Ca, calcium; P, phosphorus

P-values represent comparisons between outpatients and inpatients dialysis patients using chi-square and Mann-Whitney U tests.

Table 2. Physical function

n	All patients	Outpatients	Inpatients	P value
Knee extensor muscle strength (kgf/kg)	0.37 (0.29-0.50)	0.41 (0.33-0.57)	0.26 (0.18-0.37)	0.00
Knee extensor muscle strength < 0.4 kgf/kg	55	48	81	0.00
Grip strength (kg)	20.6 (14.8-28.7)	22.5 (15.8-29.5)	15.5 (11.1-22.3)	0.01
Grip strength < men, 26 kg; women, 18 kg	60	52	89	0.00
SPPB (points)	10 (8-12)	11 (9-12)	3 (1-7)	0.00
SPPB < 9 points	65	60	94	0.01

The data are shown in median values (25th-75th percentile) and n (%).

SPPB, short physical performance battery

P-values represent comparisons between outpatients and inpatients dialysis patients using chi-square and Mann-Whitney U tests.

from 14% to 73%, and this broad range of incidence of frailty may be associated with the fact that the nationalities of the patients included in the study were diverse, as some patients were from the United States, Brazil, and Taiwan, and the insurance systems and quality of dialysis care differed in these countries. In addition, the method of assessing frailty is also different in these countries, which may have influenced the results. Moreover, the physicians in our study prescribed physical therapy when they judged that the patients had both decreased physical function and ADL, or were at an increased risk of decreased physical function. It may be the reason why

the proportion of patients with frailty was higher in our study than in previous studies. Several recent systematic reviews have reported that exercise improves cardiorespiratory tolerance and the walking ability of hemodialysis patients^{15,16}. However, there is insufficient evidence for studies examining the effects of rehabilitation on frailty and sarcopenia separately in outpatients and inpatients. Therefore, it would be better to continue to collect and analyze data for both outpatients and inpatients, as in our study.

Based on our data set, inpatients on dialysis had a higher prevalence of coronary artery disease than outpatients not on

dialysis, and had a higher rate of orthopedic disease, followed by cardiovascular and cerebrovascular diseases, as reasons for hospitalization. Cardiovascular diseases, such as severe vascular calcification, myocardial microvascular disease, and asymptomatic myocardial ischemia, are reportedly common in patients¹⁷ on dialysis, these patients have a high incidence of sudden cardiac death and fatal arrhythmia¹⁸. It is conceivable that physical therapy may have been prescribed for such hospitalized patients with cardiac disease, along with the recovery of cardiac functions necessary for daily life. Therefore, inpatients on dialysis who underwent physical therapy were at a higher risk of cardiovascular disease than outpatients on dialysis who underwent physical therapy. Moreover, inpatients on dialysis had a high prevalence of diabetic neuropathy. Comorbidities, specifically diabetic neuropathy and LEAD, are risk factors for chronic limb-threatening ischemia; therefore, inpatients on dialysis have a higher risk of amputation¹⁹.

Our inpatients on dialysis had lower levels of Hb and Alb, and had a greater tendency toward anemia and undernutrition than our outpatients on dialysis. The median Hb level was 9.70 g/dL, which was below the 10 g/dL criterion required to start anemia treatment in patients on hemodialysis²⁰. While this suggests that several inpatients on dialysis required medical management of their anemia, the blood biochemistry findings in the outpatients on dialysis were similar to those of the 306 outpatients on dialysis who underwent intra-dialytic exercise in another study²¹.

This study has several limitations. All participants received intervention from physical therapists. In the Japanese healthcare system, all patients start physical therapy after their physicians conclude that they require rehabilitation. In other words, the involvement of physical therapists was determined at the discretion of the physicians at each facility. Thus, the level of deterioration in physical function varied from mild to disability. Therefore, caution is required when attempting to generalize the results of this study. Moreover, this study had a cross-sectional design, small sample size, and assessment of results at only one time point.

In conclusion, a large number of patients on dialysis, who

received a prescription for physical therapy, had frailty, sarcopenia, and physical function below the reference values. In addition, the physical function of inpatients on dialysis was particularly low.

Conflict of Interest

The authors declare no conflict of interest.

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