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Impact of visual impairment on physical function, activities of daily living, and length of hospital stay in patients with phase 1 cardiac rehabilitation: A Cohort Study

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Impact of visual impairment on physical function, activities of daily living, and length of hospital stay in patients with phase 1 cardiac rehabilitation: A Cohort Study

Abstract

The number of patients with visual impairment (VI) is increasing rapidly around the world, and its negative effects are becoming a problem. There is a strong relationship between VI and cardiovascular disease, and that patients with cardiovascular disease have a higher prevalence of VI.

The aim of this study was to examine the effects of VI on physical function, activities of daily living, and length of hospital stay in phase 1 cardiac rehabilitation (CR) patients.

This prospective multicentre cohort study included patients who underwent phase 1 CR from October 2020 to March 2023 at four affiliated Regional Medical Care Support Hospitals in Japan. VI was assessed by a self-reported questionnaire. Linear mixed model analysis was performed to evaluate the association between VI and walking speed, short physical performance battery (SPPB), functional independence measure (FIM), and length of hospital stay, respectively.

Of the 3608 patients with a hospital stay of at least 5 days and who underwent phase 1 CR, 565 were included in this study. VI was reported by 23.9%. The VI group had slower walking speed (0.89 vs 1.01 m/s, P <0.001), lower short physical performance battery (SPPB) (11.0 vs 12.0 points, P < 0.001), and lower functional independence

measure (FIM) (122.0 vs 125.0 points, $P < 0.001$) than the non-VI group. There was no significant difference in length of hospital stay between the two groups. Multivariate linear regression analysis adjusted for confounding factors showed that VI was significantly associated with walking speed ($P = 0.030$) and length of hospital stay ($P = 0.017$). Whereas, VI was not associated with SPPB and FIM.

This study revealed that phase 1 CR patients with VI decreased walking speed, which corresponds to sarcopenia. Furthermore, VI was independently associated with walking speed and length of hospital stay in phase 1 CR patients.

Keywords: visual impairment, physical function, activities of daily living, length of hospital stay, phase 1 cardiac rehabilitation

Introduction

In recent years, visual impairment (VI) has become a worldwide issue. The World Report on Vision published by the WHO in 2019 reported that at least 2.2 billion people around the world have VI (World Health Organization [WHO], 2019). Furthermore, VI is expected to increase dramatically in the future due to aging, lifestyle changes, and

urbanization (Burton et al., 2021). There is a strong relationship between VI and cardiovascular disease, as many eye diseases that cause VI interact with cardio-metabolic risk factors (Han et al., 2022). It has also been reported that patients with cardiovascular disease have a higher prevalence of VI (De La Cruz et al., 2021). Therefore, the global increase in VI is also a concern for patients with cardiovascular disease.

However, few studies have investigated the prevalence of VI and its impact in phase 1 cardiac rehabilitation (CR) patients. VI has been reported to affect physical function and activities of daily living (ADL) decline. Several studies in community-dwelling older adults reported that VI was associated with gait speed, short physical performance battery (SPPB), and frailty (S Swenor et al., 2014; Thompson et al., 2023; Kawaguchi et al., 2023). Regarding the disease causing VI, diabetes is strongly related to cardiovascular disease, and it has been demonstrated that the risk of sarcopenia increases when diabetic retinopathy is present (Fukuda et al., 2017). Age-Related Macular Degeneration, which has been shown to be associated with cardiovascular disease (CVD) (Wu et al., 2014), increases the risk of ADL disability (Gopinath et al.; 2014). For phase 1 CR patients, physical function and ADL at discharge are indicators to consider as they influence prognosis. In addition, it is highly likely that these

functions will be impaired in patients with VI, and there is concern that this may affect length of hospital stay.

Therefore, the purpose of this study was to examine the effects of VI on physical function, ADL, and length of hospital stay in phase 1 CR patients.

Methods

Study design and study population

This prospective multicentre cohort study named K-CREW (Kobe-Cardiac Rehabilitation project for people around the World) included patients who had a hospitalization of at least 5 days and underwent phase 1 CR from October 2020 to March 2023 at four affiliated Regional Medical Care Support Hospitals in Japan. Exclusion criteria were patients with probable dementia (based on diagnosis or Mini-Mental State Examination score <24), difficulty walking alone, disagreement with informed consent, hospital death, and data deficits.

The procedures in this study were carried out in accordance with the Declaration of Helsinki. Informed consent was obtained from each patient. This study was approved by the institutional review board for ethics at the Graduate School of Health Sciences,

Kobe University (Approval no. 951-1), and each affiliated hospital received approval from its local ethics committee.

Phase 1 cardiac rehabilitation

Phase I CR was defined as in-hospital programs consisting of exercise and education (Bjarnason-Wehrens et al., 2010). Cardiac rehabilitation program was based on the JCS/JACR 2021 Guideline on Rehabilitation in Patients with Cardiovascular Disease (Makita et al., 2022). CR started within three days after admission and cardiac surgery. The exercise program included aerobic exercise and resistance training with 20–40 minutes daily, 5–7 days a week based. The aerobic exercise program differed slightly in affiliated hospitals and was implemented for up to 25 minutes. The exercise intensity was adjusted regarding the Borg scale 11-13 or the patient's anaerobic metabolism threshold. Resistance training targeted limb muscles mainly for 10-20 minutes. Patient education included disease management and lifestyle modification lectures from a multidisciplinary team consisting of doctors, nurses, registered dietitians, pharmacists, physical/occupational therapists, and health and fitness instructors.

Data collection

Patients' characteristics and clinical parameters were collected from the medical records. At the time of admission: age, sex, body mass index (BMI), long-term care insurance (LTCI), comorbidities, and main diagnosis. At the time of discharge: medications, 14-item Health Literacy Scale (14-item HLS) (Suka et al., 2013), functional independence measure (FIM), and SPPB. Days from admission to start walking start and length of hospital stay was also recorded.

Visual impairment

VI was assessed by a self-reported questionnaire with the following item: Feel that the print is too small for me to read (even though I wear glasses). This item is one of the 14-item HLS. Response was on a 5-point scale indicating how much the patient agreed or disagreed with the question. The possible answers were: The possible answers were: (1) Strongly agree, (2) Agree, (3) Not sure, (4) Disagree, (5) Strongly disagree, Patients who answered (1) Strongly agree or (2) Agree were classified into the VI group, and patients who answered (4) Disagree or (5) Strongly disagree were classified into the non-VI group.

Physical function and ADL

Physical function was assessed using walking speed and the SPPB (Guralnik et al., 1994). SPPB consist of (1) a 4-m usual pace walking, (2) a five-repetition chair stand without using one's arms, and (3) a progressive test of standing balance. Times from each component were scored from 0-4, and the total score ranges from 4 to 12 points. Higher scores indicate better physical performance. Walking speed (m/s) was calculated by 4-meter usual pace walk. Patients were instructed to walk at their usual pace from a standing position behind the starting line. The measurement begins with the first foot movement and ends when the foot completely crosses the goal line. The use of walking aids such as canes and walkers are permitted.

ADL was assessed using FIM, which consists of an 18-item measurement tool that evaluates motor (physical) and cognitive function (Ottenbacher et al., 1996). The motor subscale is composed of 13 items (eating, grooming, bathing, dressing of upper and lower body, toileting, bladder and bowel management, transferring between bed and chair, transferring in toilet and shower, walking and climbing stairs), and a cognitive subscale of 5 items (comprehension, expression, social interaction, problem solving and memory). Each item is scored on a 7-point ordinal scale, ranging from 1 ("total assistance with helper") to 7 ("complete independence with no helper").

Physical function and ADL were evaluated by physical therapists and health exercise instructors engaged in cardiac rehabilitation.

Statistical analysis

Patients were divided into five groups based on their responses to the VI questionnaire. Data are expressed as median (interquartile range) for continuous variables. Categorical variables are presented as numbers and percentages. The Kruskal-Wallis test, the $\chi 2$ test, and Fisher's exact test were used for comparison among groups. We compared walking speed between the VI group and the non-VI group using the Mann–Whitney test. A linear mixed model analysis was performed to evaluate the association between VI (5 category) and walking speed, SPPB, FIM, and length of hospital stay, respectively. The fixed effects were based on the clinical point of view and previous studies (Kanejima et al., 2020; Ishihara et al., 2021: Kanejima et al., 2022; Kitamura et al., 2021; Kitamura et al., 2018; Kanejima et al., 2023). Facility was taken as random effects. A P-value of <0.05 was considered to indicate statistical significance. The statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria).

Results

Of the 3,608 patients who had a hospitalization of at least 5 days and underwent phase 1 CR, 565 patients were included in the final analysis (Figure 1). The mean age was 70.6 ± 12.7 years, and 73.5% were male. The patient's characteristics are summarized in Table 1. The proportion of patients who answered "strongly agree" or "agree" to "Feel that the print is too small for me to read (even though I wear glasses)" was 4.8% (n = 27) and 19.1% (n = 108), respectively. On the other hand, 20.5% (n = 116) and 46.4% (n = 262) of patients answered "disagree" and "strongly disagree," respectively.

The VI group (strongly agree or agree) was 23.9% (n = 135), and the non-VI group (disagree or strongly disagree) was 66.9% (n = 378). Figure 2 shows a comparison of physical function, ADL, and length of hospital stay between the VI group and the non-VI group. The VI group had slower walking speed (0.89 vs 1.01 m/s, P <0.001), lower SPPB (11.0 vs 12.0 points, P < 0.001), and lower FIM (122.0 vs 125.0 points, P < 0.001) than the non-VI group. There was no significant difference in length of hospital stay between the two groups (15.0 vs 15.0 days, P = 0.995).

Multivariate linear regression analysis adjusted for confounding factors showed that VI (5 category) was significantly associated with walking speed ($P = 0.030$) and length of hospital stay ($\beta = P = 0.017$). Whereas, VI was not associated with SPPB ($P = 0.203$) and FIM ($P = 0.194$) (Table 2, 3).

Discussion

This study demonstrated that VI is independently associated with walking speed and length of hospital stay in phase 1 CR patients. On the other hand, VI had no independent relationship with SPPB or FIM. Approximately one-quarter of patients are found to have VI, which is a prevalence that cannot be overlooked.ne

In this study, the proportion of patients who answered “strongly agree” or “agree” to “Feel that the print is too small for me to read (even though I wear glasses)” was 4.8% and 19.1%, respectively. Group VI consisted of patients who chose these two answers, accounting for 23.9%.

There are very few papers that report the distribution of each of the five levels for the sub-items of 14-HLS. In a report from Brazil targeting adults and elderly people, the proportion of VI was 61.6%, which was much higher than the results of present study

(Batista et al., 2020). In this report, the median 14-HLS score was 34.0 points. This score is low even compared to the 47.1 points in this study, and considering that the definition of low health literacy used in several previous studies is 50 points or less (Suka et al., 2013). This report examining the reliability of assessments using the 14-HLS in Brazil concludes that there are issues with comparisons with other countries. According to a report that investigated VI among functionally independent older Japanese people using a five-level self-report VI evaluation method, 13.8% were classified as VI (Kawaguchi et al., 2023). The mean age of the subjects was 73.2 ± 5.6 years, which was not significantly different from the 70.6 ± 12.7 years in our study. The higher prevalence of VI in patients with cardiovascular disease may have contributed to the higher proportion of VI in our study subjects. There have been several reports on the prevalence of VI in CVD patients. It has been reported that the proportion of low Vison estimated from the cause of VI was 26% in men and 32% in women, which was higher than 7% in non-CVD patients (Buddeke et al., 2019). The results of a study investigating the prevalence of VI in middle-aged and older heart disease patients was 17.1% (Ye et al., 2022). Furthermore, in a study targeting patients with heart failure, the prevalence of VI was 23.8% (Sterling et al., 2018), which is almost the same as the

present study. Therefore, previous studies have suggested that 17-30% of patients with cardiac disease have VI, and the results of our study were also within this range.

This is the first study to clarify that VI affects walking speed in patients with cardiac disease. Walking speed has been established as an important predictor of prognosis in patients with cardiac disease (Kamiya et al., 2018), and is an indicator that plays an important role in daily clinical practice. The median walking speed of group VI was 0.89 m/s, which was below the cutoff value of <1.0 for sarcopenia diagnosis according to AWGS2019 (Chen et al., 2020). Furthermore, in a study of walking speed in heart failure patients, patients with a walking speed <1.0 m/s were reported to have a poor prognosis (Pulignano et al., 2016). Additionally, the difference in walking speed between the VI and non-VI groups was 0.12 s/m. This exceeded the value of 0.1s/m shown as a substantial meaningful change in 4m walking speed (Perera et al., 2006). Therefore, it was shown that the decrease in walking speed in cardiac disease patients with VI is at a stage where countermeasures are required.

VI was an independent determinant of walking speed even after multivariate adjustment. There are several causes why VI affects walking speed. In this study, the VI was assessed by the questionnaire "Feel that the print is too small for me to read (even though I wear glasses)". This question applies to near VI, which can be caused by

refractive error, distorted vision, or blurred vision. Background diseases of near VI include diabetic retinopathy, cataract, glaucoma, age-related macular degeneration, and presbyopia. These diseases also affect distance VI (World Health Organization [WHO], 2019), causing a decrease in walking speed (Varadaraj et al., 2019).

The cause of the decrease in walking speed due to VI may be the difficulty in instantaneous adaptation. VI patients walk slowly in an effort to maintain or improve their perception of mobility safety (S Swenor et al., 2014). Based on previous research that revealed that VI leads to decreased physical activity (Ong et al., 2018), decreased physical activity due to VI may contribute to slow walking speed through decreased physical function. However, in this study, although the VI group had significantly lower SPPB and FIM values than the non-VI group, the VI group showed higher SPPB and FIM values at 11 points and 122 points, respectively. This suggests that the decrease in activity due to VI caused a decrease in physical function and ADL, which did not lead to a decrease in walking speed. This implies that VI itself can contribute to walking speed. Therefore, interventions that improve physical function alone are insufficient to improve walking speed in cardiac disease patients with VI. As a countermeasure, it is necessary to identify and treat the underlying disease that causes VI, and to improve the environment.

Future verification is required to determine whether improvement in walking speed by VI treatment contributes to prognosis improvement in the same as exercise therapy. However, improved walking speed can lead to increased physical activity (Best et al., 2018). Therefore, it is possible that increased physical activity due to improved VI and subsequent improvement in physical function may lead to improved prognosis.

Regarding SPPB, the VI group had significantly lower SPPB than the non-VI group. However, the median SPPB of the VI group was 11.0, which exceeds the cutoff value for poor physical performance ≤9 indicated by AWGS 2019 (Chen et al., 2020). Considering that the full score of SPPB is 12 points, the physical performance of group VI was preserved. Among the components of SPPB, this study revealed that VI has an effect on walking speed, but visual information may be less important for standing up and static balance. In regard to FIM, VI was not a factor associated with FIM. This study excluded patients with difficulty walking alone, and the ADL of the subjects was high, and the median FIM score in group VI was 122.0 points. FIM reports for hospitalized patients with cardiac disease showed scores of 96-108 (Iwata et al., 2021; Igarashi et al., 2022). Although it has been reported that VI affects FIM (Gopinath et al., 2014), the fact that our subjects had relatively high ADL may be one of the reasons why VI did not affect FIM.

However, it is suggested that in patients with VI, walking speed may be reduced even if SPPB and FIM are maintained. It is necessary to consider that these patients are at risk of decreased ADL and poor prognosis in the future (Wang et al., 2020; Fuentes-Abolafio et al., 2020). Finally, VI was an independent associated factor of length of hospital stay. The median length of hospital stay was 15.0 days for both the VI and non-VI groups, with no significant difference. In this study, we were not able to verify the background of the relationship between VI and length of hospital stay. There are few reports on the effect of VI on hospital stay, not only in patients with cardiac disease but also in other diseases. A report examining VI and length of stay in acute care hospitals in 1999 also stated that patients with VI had significantly longer length of stay in the hospital, but the reason could not be determined (Morse et al., 1999). It was mentioned that one possibility is the influence of decreased ADL in VI patients. However, in the present study, VI was a predictor of length of stay even after adjusting for physical function and ADL, suggesting the existence of other background factors. Future studies are needed to understand the underlying mechanism with detailed information about VI.

Limitations

First, this study included several cardiac diseases in the main diagnosis and comorbidities that require different treatments. Second, the results of this study are only

generalizable in patients with relatively preserved ADL, which means that the results may be different in patients with low ADL. Third, in this study, there were 914 patients who did not meet the exclusion criteria. Since this breakdown is unknown, it is necessary to reset the exclusion criteria. Finally, VI was not objectively measured but self-reported. Self-report evaluation is the mainstream for VI. A one-item question on self-experienced visual acuity has been shown to be significantly associated with objectively measured visual acuity (Zimdars et al., 2012). We were able to ensure that the prevalence of VI in the questionnaire items used in this study was within the same range as previous reports. However, Since the question item has no consensus yet, it is necessary to develop an evaluation method with both distant vision and near vision.

Conclusions

This study revealed that phase 1 CR patients with VI decreased walking speed, which corresponds to sarcopenia, despite preserved SPPB and FIM. In addition, VI was found to be a determining factor for walking speed and length of hospital stay in phase 1 CR patients. This study also proved that VI is one of the important pathologies in phase 1 CR patients. VI should be considered as an intervention to improve physical function and reduce hospital stay in Phase 1 CR patients.

Author contributions

Asami Ogura designed the study and wrote the first draft of the manuscript with Kazuhiro P. Izawa, Yuji Kanejima, Masahiro Kitamura, Kodai Ishihara and Ikko Kubo. Asami Ogura and Yuji kanejima developed the statistical analysis plan and performed the statistical analyses. Peter H. Brubaker, Hitomi Nagashima, Hideto Tawa, Daisuke Matsumoto, and Ikki Shimizu revised the article critically for important intellectual content. All authors have given final approval for the current version to be published.

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Conflicts of interest

Dr. Kazuhiro P. Izawa is an editorial board member of *Heart and Mind*. The article was subject to the journal's standard procedures, with peer review handled independently of Dr. Kazuhiro P. Izawa and the research groups. There are no conflicts of interest.

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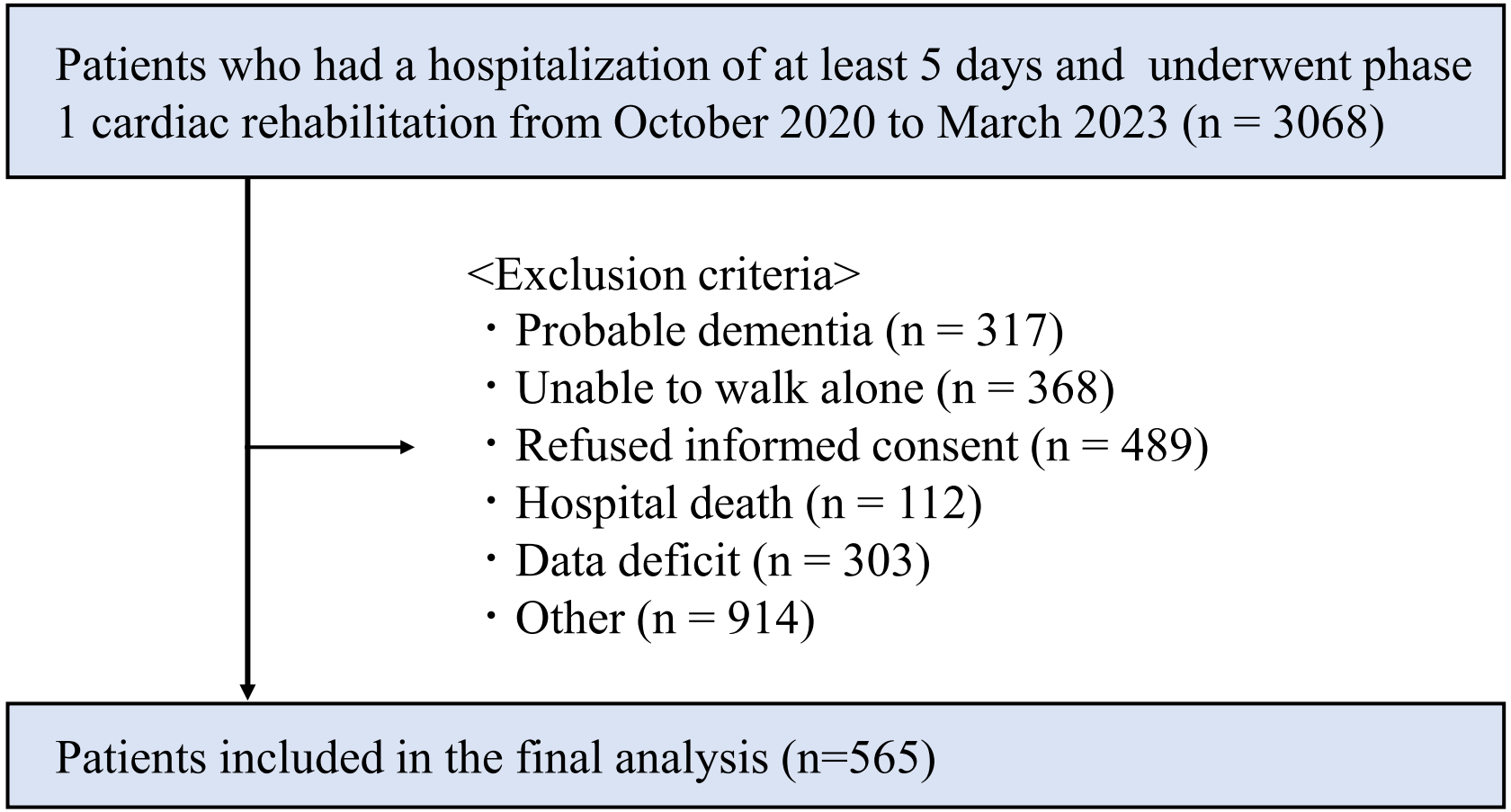
Patients who had a hospitalization of at least 5 days and underwent phase 1 cardiac rehabilitation from October 2020 to March 2023 (n = 3068)
<Exclusion criteria>
・Probable dementia (n = 317)
・Unable to walk alone (n = 368)
・Refused informed consent (n = 489)
・Hospital death (n = 112)
・Data deficit (n = 303)
・Other (n = 914)
Patients included in the final analysis (n=565)

Figure 1

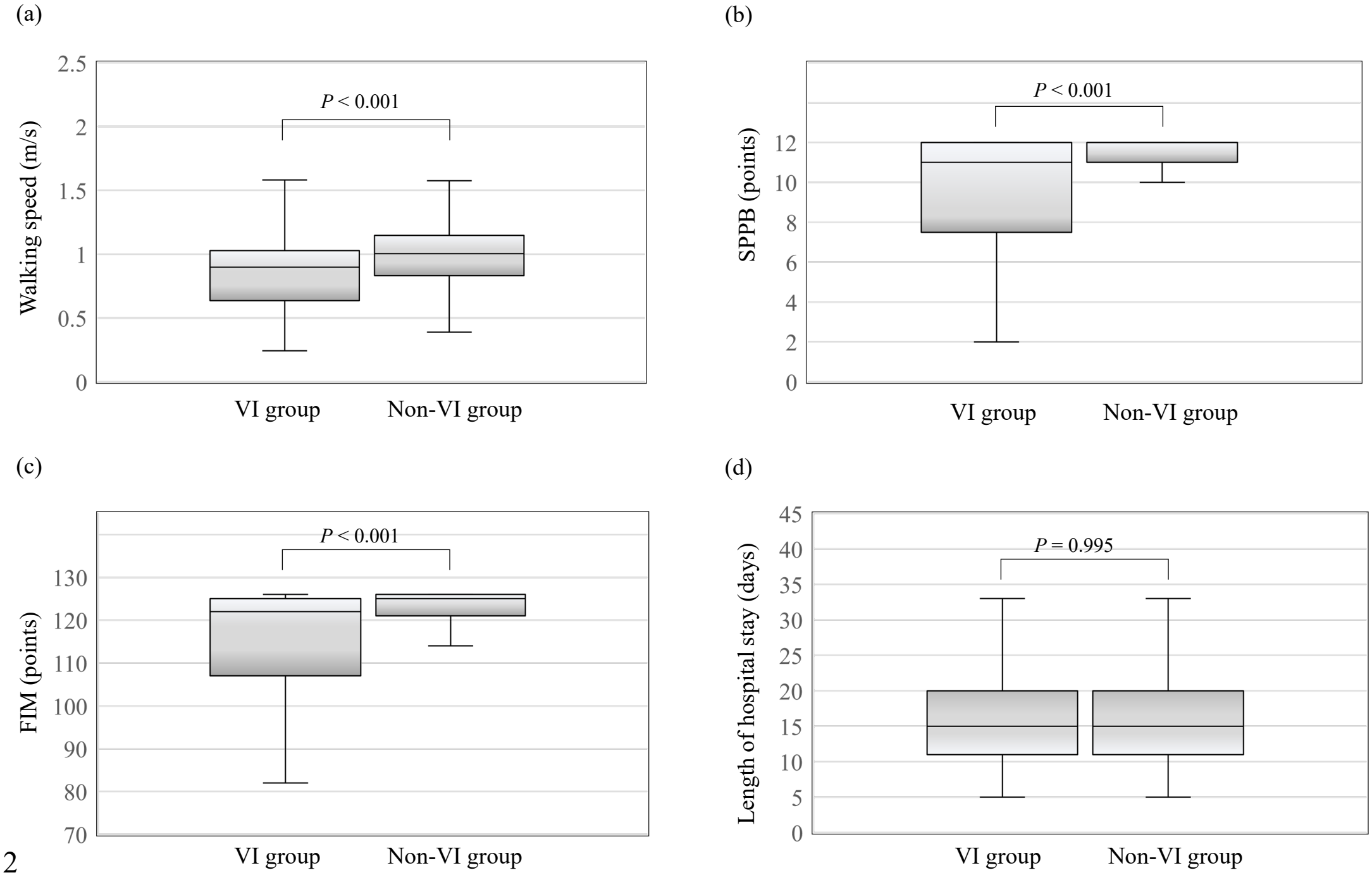
(a)
Walking speed (m/s)
2.5
2
1.5
1
0.5
0
P < 0.001
VI group
Non-VI group
(b)
SPPB (points)
12
10
8
6
4
2
0
P < 0.001
VI group
Non-VI group
(c)
FIM (points)
130
120
110
100
90
80
70
P < 0.001
VI group
Non-VI group
(d)
Length of hospital stay (days)
45
40
35
30
25
20
15
10
5
0
P = 0.995
VI group
Non-VI group

Figure 2

Table 1. Patient characteristics.

	Feel that the print is too small for me to read (even though I wear glasses)					
	Strongly agree n = 27	**Agree n = 108**	**Not sure n = 52**	**Disagree n = 116**	**Strongly disagree n = 262**	***P*-value**
Age, years	76.0 (72.5-81.5)	77.0 (68.8-82.3)	73.5 (61.8-80.3)	72.0 (62.0-76.0)	72.0 (59.0-78.0)	<0.001
Male, n (%)	17 (63.0)	76 (70.4)	42 (80.8)	89 (76.7)	191 (72.9)	0.386
Body mass index, kg/m^2	23.2 (21.5-24.5)	22.5 (20.0-24.4)	23.6 (19.5-25.8)	23.0 (20.7-25.5)	23.5 (21.2-26.0)	0.193
LTCI level, none/support1,2/ care1,2,3,4,5; %	74.1/3.7/0 14.8/3.7/3.7/0/0	75.9/6.5/5.6 8.3/1.9/0.9/0/0.9	90.4/1.9/1.9/ 1.9/1.9/1.9/0/0	90.5/1.7/4.3 0.9/1.7/0.0/0.9/0	91.6/3.4/2.7/ 1.5/0.4/0/0/0.4	0.003
Main Diagnosis						
HF, n (%)	11 (40.7)	45 (41.7)	25 (48.1)	43 (37.1)	82 (31.3)	0.110
AMI, n (%)	9 (33.3)	39 (36.1)	17 (32.7)	53 (45.7)	135 (51.5)	0.013
AP, n (%)	2 (7.4)	13 (12.0)	3 (5.8)	6 (5.2)	20 (7.6)	0.421
Valve surgery, n (%)	4 (14.8)	6 (5.6)	5 (9.6)	4 (3.4)	9 (3.4)	0.045
other, n (%)	1 (3.7)	5 (4.6)	2 (3.8)	10 (8.6)	16 (6.1)	0.758
Co-morbidity						
Locomotor diseases, n (%)	6 (22.2)	26 (24.1)	7 (13.5)	19 (16.4)	31 (11.8)	0.045
Stroke, n (%)	5 (18.5)	15 (13.9)	9 (17.3)	12 (10.3)	22 (8.4)	0.139
Diabetes, n (%)	10 (37.0)	45 (41.7)	26 (50.0)	46 (39.7)	94 (35.9)	0.393
Renal disease*, n (%)	8 (29.6)	20 (18.5)	9 (17.3)	16 (13.8)	31 (11.8)	0.093
MCI, n (%)	4 (14.8)	25 (23.1)	12 (23.1)	25 (21.6)	39 (14.9)	0.225
Medications						
Beta blockers, n (%)	20 (74.1)	87 (62.0)	35 (68.6)	84 (71.8)	180 (68.7)	0.549
Diuretics, n (%)	18 (66.7)	66 (61.1)	34 (67.3)	68 (58.6)	139 (53.1)	0.220
Statin, n (%)	12 (44.4)	55 (50.9)	29 (55.8)	70 (60.3)	174 (66.4)	0.023
Length of hospital stay, days	14.0 (12.0-20.5)	15.0 (11.0-20.0)	14.5 (11.0-19.5)	15.0 (12.0-20.0)	15.0 (11.0-19.8)	0.928
Days to start walking, days	3.0 (2.0-6.0)	3.0 (2.0-4.0)	3.0 (2.0-5.0)	3.0 (2.0-4.0)	3.0 (2.0-4.0)	0.775
14-items HLS	38.0 (33.5-47.5)	42.0 (37.0-46.0)	43.0 (38.8-47.0)	46.5 (41.8-53.0)	52.0 (46.0-56.0)	<0.001
FIM	123.0 (114.0-125.0)	122.0 (106.0-125.0)	124.0 (118.0-126.0)	124.0 (121.0-126.0)	125.0 (121.0-126.0)	<0.001
SPPB total	11.0 (9.5-12.0)	11.0 (7.0-12.0)	12.0 (9.8-12.0)	12.0 (11.0-12.0)	12.0 (11.0-12.0)	<0.001
5-time chair stand	4.0 (3.0-4.0)	4.0 (2.0-4.0)	4.0 (3.0-4.0)	4.0 (3.0-4.0)	4.0 (4.0-4.0)	<0.001
Standing balance	4.0 (4.0-4.0)	4.0 (3.0-4.0)	4.0 (3.0-4.0)	4.0 (4.0-4.0)	4.0 (4.0-4.0)	<0.001
Waking speed	4.0 (3.0-4.0)	4.0 (2.0-4.0)	4.0 (3.0-4.0)	4.0 (3.0-4.0)	4.0 (4.0-4.0)	<0.001
Walking speed, m/s	0.91 (0.68-1.0)	0.86 (0.63-1.04)	0.95 (0.75-1.07)	0.98 (0.80-1.12)	1.02 (0.85-1.16)	<0.001

LTCI, long-term care insurance; HF, heart failure; AMI, acute myocardial infarction; AP, angina pectoris; MCI, mild cognitive impairment; HLS, health literacy scale; FIM, functional independence measure; SPPB, short physical performance battery.
*Renal disease: dialysis, status post kidney transplant, uremia, creatinine >3 mg/dL
Values shown are % (n), median (interquartile range).

Table 2. Linear mixed model analysis on the association between VI and physical function.

	Walking speed		SPPB		FIM	
	Estimate	*P*-value	Estimate	*P*-value	Estimate	*P*-value
Age	-0.005	<0.001	-0.039	<0.001	-0.048	0.093
Sex	0.022	0.266	0.131	0.454	-0.053	0.940
LTCI level	-0.017	0.069	-0.443	<0.001	-0.854	0.013
Main diagnosis	0.010	0.126	0.074	0.198	0.386	0.097
Stroke	-0.012	0.673	0.092	0.702	-1.904	0.048
Locomotor diseases	0.004	0.884	-0.824	<0.001	-0.209	0.807
Diabetes	-0.020	0.245	-0.350	0.019	1.213	0.045
Renal disease*	-0.008	0.709	-0.382	0.040	-0.879	0.245
MCI	-0.045	0.080	-0.997	<0.001	-1.298	0.157
14-HLS	-0.001	0.514	0.011	0.236	0.085	0.026
Length of hospital stay	-0.002	0.013	-0.012	0.170	-0.105	0.002
Days to start walking	0.001	0.672	0.007	0.732	-0.087	0.297
SPPB						
5-time chair stand	0.082	<0.001	-	-	0.924	0.027
Standing balance	0.044	0.001	-	-	2.714	<0.001
Waking speed	-	-	-	-	2.760	<0.001
VI	0.019	0.030	0.081	0.203	0.332	0.194

VI, visual impairment; SPPB, short physical performance battery; FIM, functional independent measurement; LTCI, long-term care insurance; MCI, mild cognitive impairment; HLS, health literacy scale.
*Renal disease: dialysis, status post kidney transplant, uremia, creatinine >3 mg/dL

Table 3. Linear mixed model analysis on the association between VI and length of hospital stay.

	Estimate	*P*-value
Age	-0.038	0.280
Sex	-1.711	0.046
LTCI level	0.414	0.323
Main diagnosis	0.525	0.051
Stroke	-1.485	0.825
Locomotor diseases	-0.265	0.801
Diabetes	0.140	0.851
Renal disease*	1.961	0.032
MCI	1.186	0.248
14-HLS	0.747	0.131
Days to start walking	1.472	<0.001
FIM	-0.109	0.018
SPPB	-0.050	0.825
VI	0.747	0.017

VI visual impairment; LTCI, long-term care insurance; MCI, mild cognitive impairment; HLS, health literacy scale; FIM, functional independent measurement; SPPB; short physical performance battery;.
*Renal disease: dialysis, status post kidney transplant, uremia, creatinine >3 mg/dL