Determinants of Participation in A Post-Hospitalization Physical Exercise Program for Older Adults

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Abstract

BACKGROUND: In older patients, functional and cognitive status often decline after hospitalization. Although interventions based on physical exercise can revert these effects, participation in physical exercise interventions is low. This study aimed to identify determinants of refusal to participate in a physical exercise program in post-hospitalized older patients.

METHODS: Cross-sectional study of recruitment data from a randomized controlled trial. A total of 509 hospitalized people ≥70 years old participated in this study. Sociodemographic and clinical data were obtained from the Basque Public Health System database. We measured physical function with the Short Physical Performance Battery (SPPB), nutritional status by the Mini-Nutritional Assessment, frailty according to the Fried phenotype criteria, and cognitive function by the Short Portable Mental Status Questionnaire (SPMSQ). Student's t, Mann-Whitney U or chi-squared tests were applied for bivariate analysis. Parameters significantly associated with participation were introduced in a logistic multivariate regression model.

RESULTS: Of evaluated patients, 10.8% declined physical exercise program participation. Multivariate regression revealed that older age (OR: 1.13; 95% CI: 1.06 - 1.18), poor nutritional status (OR: 0.82; 95% CI: 0.69 - 0.96), and worse home accessibility (OR: 0.26; 95% CI: 0.07 - 0.9) were predictors of lower participation. Moreover, patients who declined participation had worse performance in SPPB ($p < 0.05$) and its three tests: balance, leg strength and walking speed ($p < 0.05$). No differences were found between groups in other variables.

CONCLUSIONS: This study confirms low participation of older adults in a post-hospitalization physical exercise program. Non-participation was associated with higher age, poorer nutritional status, and reduced home accessibility. Our findings support the need to design interventions accounting for these determinants to increase older patient participation.

TRIAL REGISTRATION: ACTRN12619000093189 (retrospectively registered): Registered January 22, 2019. KEY WORDS Physical exercise, older people, participation, post-hospitalization

Background

Increasing evidence suggests that older patients' physical and cognitive function usually decline after hospitalization from an acute illness (1, 2). Additionally, loss of physical and cognitive capacities may continue even months after discharge (3, 4).

Functional decline has been directly related to negative outcomes in the year following hospital admission, including dependence, increased risk of institutionalization, and even mortality (5). Total medical expenditures at one year post-discharge grow in proportion to functional impairment, indicating a potential economic impact of loss of physical and cognitive function following hospitalization (6).

Physical exercise is an effective intervention to improve physical and cognitive performance. Recent studies indicate that multicomponent exercise interventions, including resistance, balance, and walking exercises performed during acute hospitalization, increase muscle strength, functional capacity, and ability to complete basic daily living activities (7). Physical exercise also benefits executive functions and memory and can reduce the risk of developing dementia (8).

Participation rates of older adults in exercise interventions are usually low (9) including interventions performed after hospital discharge with a wide range of acute processes (10). In contrast, post-hospitalization exercise programs for cardiac rehabilitation, in which physical exercise is well-established as part of treatment, have higher participation (11).

To implement strategies to increase participation in physical exercise programs, it is important to determine factors associated with refusal to participate. Deer et al. highlighted the importance of identifying potential barriers to developing post-hospitalization interventions (10). Studies exploring older patients' reasons for non-participation in clinical trials have been performed through surveys or interviews without accounting for clinical or functional variables (12, 13). Therefore, the first aim of the present study was to identify older adults' reasons for rejecting participation in a physical exercise program after hospital discharge. Secondly, we sought to analyze objectively measured physical, clinical, and sociodemographic factors associated with non-participation. This knowledge will help develop future strategies to increase older adult participation in physical exercise programs following hospitalization.

Methods

Study design and participants

This cross-sectional study was a secondary analysis based on data obtained from recruitment for a randomized controlled trial (RCT) (14). The protocol was registered retrospectively under the Australian and New Zealand Clinical Trials Registry with the identifier ACTRN12619000093189 (date of registration: 22/01/2019). The Clinical Research Ethics Committee University Hospital of Araba (2017-021) approved the study protocol, which complied with the revised ethical guidelines of the Declaration of Helsinki (2013 revision). All participants provided informed written consent before enrollment in the study.

RCT enrollment data were obtained from September 2017–July 2018 in the Departments of Internal Medicine and Neurology of Santiago University Hospital of Araba (Basque Country, Spain). Eligible participants included men and women ≥ 70 years old who scored ≥ 20 on the Mini-Mental State Examination (MMSE) (15) and were able to stand and walk independently or with assistance for at least 4 meters. The MMSE is a 30-point test used in clinical settings to measure cognitive impairment and to screen for dementia. The cut-off point was set at ≥ 20 to ensure patients could follow the instructions of the physical exercise program. Exclusion criteria were a diagnosis of chronic kidney disease, autoimmune neuromuscular disease, acute myocardial infarction or bone fracture in the past three months.

During the recruitment period, a total of 2.365 patients were admitted to the Departments of Internal Medicine and Neurology (wards with a high prevalence of older patients) of University Hospital of Araba, a tertiary teaching hospital in Basque Country. After screening medical histories and inclusion criteria, 509 patients were eligible to initiate the physical exercise program at discharge. After signing an informed consent document, a comprehensive geriatric assessment was performed by nurses and physicians of the hospital staff and physiotherapists of the research team. Once assessment of each patient was completed, they were proposed to start a physical exercise program in the same hospital at discharge. Once per week, we provided informative sessions and informational leaflets throughout the hospital. Of the evaluated patients, 106 agreed to participate in the physical exercise program, of which 55 started the program (Fig. 1). The first participants started the exercise intervention in November 2017 and the last participants ended the program in January 2019. The program consisted of individualized multicomponent physical exercise sessions designed to improve strength, power, balance and walking retraining. Subjects who agreed to take part in the intervention were randomly assigned to a short (6 weeks) or long (12 weeks) supervised exercise program. In both groups, participants continued the program at home from 6 weeks (short supervised) or 12 weeks (long supervised) until 24 weeks after the start of the intervention. The intervention was adapted to meet the exercise and physical activity guidelines for older adults established by the American College of Sport Medicine (ACSM) and American Heart Association. The intervention consisted of 60-minute group sessions (supervised) conducted twice per week. All sessions began with a brief warm-up of 5 minutes and continued with strength training (35 minutes). This training comprised upper and lower body exercises performed with external weights, which were tailored to the individual's functional capacity. Finally, balance training (15 minutes) included exercises progressing in difficulty starting by decreasing arm support along with decreasing the base of support and increasing complexity of movements. Walking retraining was implemented through individualized recommendations for patients to perform walking sessions on their own.

We asked patients who refused participation in the exercise program to provide reasons for not participating. We categorized refusal reasons as internal reasons, external reasons, and trial-related reasons (16). Internal reasons were related to the patients themselves (poor health perception or too active to participate). External reasons were those related to the patient's social burdens (travel problems, being a family caregiver, or social problems). Trial-related reasons were specifically related to not having interest in being involved in the physical exercise program.

Measurements

Sociodemographic and clinical data were retrieved from the Basque Public Health Service's database. The following data were collected: patient demographic data (sex and age), days of hospitalization, previous year hospitalizations, emergency care admissions, and comorbidity (assessed through the Charlson comorbidity index, a method of categorizing patient comorbidities based on the International Classification of Diseases) (17). We collected the Barthel Index score, a scale that measures performance in basic activities of daily living such as continence and mobility (18). In addition, we collected the Lawton Index score that measures the instrumental activities of daily living necessary for independence

in the community, (19). Finally, we collected socio-demographic data including patients' educational level, whether or not they live alone, use of assistive devices for walking and home accessibility, defined as not having home entrance-related environmental barriers, i.e., elevator or lift (20).

Physical function was measured individually in a patient's hospital room by the Short Physical Performance Battery (SPPB) (21). SPPB is a battery of tests that combines assessment of balance, gait speed, and lower limb strength. The balance test measured ability to stand for 10 seconds in side-by-side, semi-tandem, and tandem stands. To assess gait speed, we twice measured the time to walk 4 meters at the participant's usual speed (participants could use a walking aid if necessary). The best walking time was scored. Finally, lower limb strength was measured by time to perform five repeated chair stands and sit-to-stand speed was measured. Each test was scored on a scale of 0–4 points, with a total performance score range of 0–12 points using cut-point criteria established by Guralnik et al. (21). Higher scores indicate better physical function.

Nutritional status was measured using the Calf Circumference Short Form of the Mini Nutritional Assessment (MNA-SF) (22). The MNA-SF is a validated screening tool designed by Nestle to identify elderly persons who are at risk of malnutrition. The test consists of 5 questions (appetite or eating problems, recent weight loss, mobility impairment, acute illness/stress, dementia or depression) and measurement of calf circumference (CC). CC was measured at the calf's greatest circumference with the patient sitting down, resting their feet on the floor, and knees bent at 90°. The test provides a maximum score of 14 points. Higher scores indicate better nutritional status.

Frailty was measured according to the Fried phenotype criteria (23). A Spanish language version of the frailty performance criteria was used to measure grip strength, walking speed, weight loss, physical activity, and exhaustion.

Cognitive function was measured by the Spanish validated version of the Short Portable Mental Status Questionnaire (SPMSQ) (24). The SPMSQ includes 10 questions to briefly test short- and long-term memory, orientation, and capacity to perform serial mathematical tasks. The total number of errors was counted, one point was subtracted if the participant had a grade school education and one point was added if the participant had a high school education.

Statistical analysis

Continuous variables were expressed as means with standard deviations (SD), and categorical variables were expressed as frequency counts and percentages (%). Sociodemographic characteristics and clinical data were compared between patients that initiated or declined participation in the post-hospitalization physical activity program. Normality of data was assessed using the Kolmogorov-Smirnov test. We used an appropriate statistical test according to the type and distribution of the data: Student's t test (normal distribution data) or Mann-Whitney U test (non-normal distribution data) for continuous variables and chi-squared test for categorical variables, considering a significance of $p < 0.05$. Variables with $p < 0.05$ in bivariate analysis were considered eligible for a logistic multivariate regression model of participation in

the intervention. The Hosmer-Lemershow test was used to determine the goodness-of-fit of the model and thus determine if the observed event rate matched the expected one. A number closer to 1 showed a better goodness-of-fit. Omnibus was used to test whether the explained variance was significantly greater than the unexplained variance; a p value < 0.05 was considered significant. Nagelkerke's R^2 value estimated the proportion of the dependent variable explained by the independent variables. Statistical analysis was performed using SPSS v.21 software.

Results

This study included 509 hospitalized older adults. The mean age of evaluated patients was 83.4 ± 6.7 years, 266 (52.3%) were men, and the mean Charlson comorbidity index was 6 ± 1.9 points. Of the reasons for hospital admission, 43.7% were infection-related, 27.2% were acute decompensated heart failure, and 13.6% were chronic airflow limitation. The remaining 15% of admissions were due to other conditions (falls, delirium, dementia, and others).

Almost 9 out of 10 evaluated patients declined participation in a post-hospitalization physical exercise program. Nearly half of participants refused participation because of a lack of interest in the physical exercise program (Table 1).

Table 1
Refusal reasons

Internal reasons	12.7%
Poor health perception	9.2%
Too active to participate	3.5%
External reasons	38.5%
Travel problems	23.8%
Other assistance resource	10.2%
Family caregiver	2.5%
Social problems	2.0%
Trial-related (not interest)	48.8%

Patients who declined to participate were significantly older than those who initiated the program (p = 0.023). Additionally, a significantly higher percentage of patients who needed walking assistance devices (p = 0.006) and had poorer accessibility at home (p = 0.017) did not participate in the program. There were no significant differences between groups regarding sex, education level, living alone, length of hospitalization, or previous year admissions (Table 2).

Table 2
Sociodemographic characteristics

	Initiated PE program (n = 55)	Declined participation (n = 454)	*p*
Age (years), mean (SD)	81.7 (5.9)	83.7 (6.8)	0.023[#]
Sex			0.941
Men, % (n)	52.7% (29)	52.2% (237)	
Women, % (n)	47.3% (26)	47.8% (217)	
Education level			0.288
≤12 years, % (n)	30.4% (7)	36.4% (126)	
>12 years, % (n)	69.6% (16)	63.6% (220)	
Length of stay (days), mean (SD)	6.8 (3.5)	7.6 (4.6)	0.132
Previous year hospital admissions			0.718
Yes, % (n)	36.4% (20)	33.9% (154)	
No, % (n)	63.6% (35)	66.1% (300)	
Previous year emergency care admissions, mean (SD)	1.7 (2.2)	1.5 (2.5)	0.153
Walking assistance device			0.006[$]
Yes, % (n)	49.1% (27)	68.1% (241)	
No, % (n)	50.9% (28)	31.9% (113)	
Lives alone			0.349
Yes, % (n)	36.4% (20)	30.1% (116)	
No, % (n)	63.6% (35)	69.9% (269)	
Home accessibility			0.017[$]
Yes, % (n)	94.5% (52)	81.6% (226)	
No, % (n)	5.5% (3)	18.4% (51)	

PE, physical exercise; SD, standard deviation

[#] Mann-Whitney U test; [$] chi square test.

	Initiated PE program (n = 55)	Declined participation (n = 454)	*p*

Patients who declined participation had significantly worse functional performance in SPPB ($p = 0.033$), including lower muscle strength in their lower limbs ($p = 0.046$), poorer balance scores ($p = 0.020$), and slower walking speed ($p = 0.012$) than participants who agreed to the exercise program (Table 3). Further, these patients had lower nutritional status according to the MNA-SF test ($p < 0.001$). Analysis of each component of the test showed that participants who refused to participate in the program had significantly lower scores for both weight ($p = 0.020$) and eating problems ($p = 0.018$). There were no significant differences between groups in Barthel and Lawton scales, cognitive status, comorbidities measured by the Charlson index, and frailty according to the Fried phenotype.

Table 3
Clinical, functional, cognitive, and nutritional parameters

	Initiated PE program (n = 55)	**Declined participation (n = 454)**	***p***
Weight (kg), mean (SD)	71.7 (15.2)	67.6 (13)	0.028*
Barthel index, mean (SD)	87 (17.3)	86.3 (17.4)	0.598
Lawton scale, mean (SD)	4.9 (2.7)	4.1 (2.7)	0.073
SPMSQ, mean (SD)	1.4 (1.5)	1.9 (2.1)	0.126
MNA-SF, mean (SD)	11.3 (2.2)	10.1 (2.5)	< 0.001#
Eating problems	1.7 (0.5)	1.4 (0.8)	0.018#
Weight loss	2.2 (1.1)	1.9 (1.2)	0.020#
Mobility	1.9 (0.3)	1.8 (0.4)	0.290
Acute illness/stress	0.8 (0.4)	0.8 (0.4)	0.602
Dementia/depression	2 (0.1)	1.9 (0.3)	0.115
Calf circumference	2.6 (1)	2.3 (1.3)	0.082
SPPB, mean (SD)	6.6 (3.1)	5.7 (3)	0.033#
Sit-to-stand speed (stand/s)	0.25 (0.16)	0.21 (0.16)	0.046#
Balance test	2.9 (1.2)	2.4 (1.4)	0.020#
Walking test (s)	7.9 (5.1)	10.9 (10.1)	0.012#
Frailty (Fried criteria), mean (SD)	2.8 (1.3)	2.9 (1.2)	0.890
Charlson comorbidity index, mean (SD)	5.9 (2.1)	6 (1.9)	0.496

PE, physical exercise; SD, standard deviation; SPMSQ, Short Portable Mental Status Questionnaire; MNA-SF, Mini Nutritional Assessment Short Form; SPPB, Short Physical Performance Battery

* Student's t test; # Mann-Whitney U test.

Further, multivariate logistic regression was performed with variables in the model (age, walking assistance device use, MNA-SF, weight, SPPB, and home accessibility). This revealed that higher age (OR: 1.13; 95% CI: 1.06–1.18), lower MNA-SF test score (OR: 0.82; 95% CI: 0.69–0.96) and lack of home accessibility (OR: 0.26; 95% CI: 0.07–0.9) were independent predictors of lower participation in the physical exercise program (Fig. 2). Estimates are based on: $n = 315$ due to missing values; Hosmer-Lemershow goodness of fit, $p = 0.723$; Omnibus $p < 0.001$; and R^2 Nagelkerke = 0.185.

Discussion

The difficulty of recruiting older people to clinical trials is well known. However, there is limited information about the potential barriers to implementation of physical post-hospitalization interventions (10) and objectively measured clinical characteristics. The present study reveals that older adults have low interest (10.8%) in participating in a post-hospitalization physical exercise program. Non-participation was associated with physical, nutritional, and social parameters. Likewise, higher age, poor nutritional status, and home accessibility problems were strong independent predictors of non-participation.

Barriers to participation in the exercise program

Most post-hospitalization physical exercise programs have been carried out in patients undergoing cardiac or lung rehabilitation or after hip or knee repair. Participation rates reported in these programs (30–70%) are higher than in our program (11, 25). These differences may be due to the fact that physical exercise is considered an essential part of treatment after the above-mentioned diseases or conditions. Moreover, physical exercise after hospitalization is strongly recommended by the European Society of Cardiology (26), American Thoracic Society, and European Respiratory Society (27), and it is usually well-accepted by patients. However, geriatric patients with broader reasons for hospitalization similar to those in our study (mainly infections) often do not consider exercise as a useful intervention after discharge. Higher participation rates were reported in previous post-hospitalization physical exercise programs for older adults. However, the participants in those interventions were slightly younger than in the present study (10, 28). Nevertheless, the participation rate in our study was similar to other physical exercise programs for community-dwelling older adults, with rates of 7.3–13% in studies with similar participant characteristics (9).

It is remarkable that the main reason for non-participation for almost half of the patients was a lack of interest in physical exercise. This lack of interest has also been described in other older adult populations who do not recognize positive health-related effects of physical activity and do not believe that being physically active is helpful (29, 30). In this sense, health professionals may play a fundamental role in informing patients about physical and cognitive deterioration associated with hospitalization (1, 2) and the benefits of physical exercise after discharge to revert these deleterious effects (7). For these reasons, it is pertinent to actively encourage patients to get involved in physical exercise programs as part of a structured post-hospitalization treatment.

We also found that poorer accessibility at home was an independent factor for non-participation in the physical exercise program. This result agrees with other qualitative studies in which accessibility or environmental barriers hinder access to exercise programs (31). Usually, poorer accessibility is associated with lower socioeconomic status, which is one of the most important predictors of negative health outcomes (32). Therefore, special efforts are needed to provide accessible transport and improve

incorporation of people with lower economic status in physical exercise programs and to encourage other healthy habits.

Participant characteristics

People who refused to participate were older than those who accepted the exercise program. Logistic regression models showed that the probability of non-participation increased by 13% with each additional year of age. This finding agrees with post-hospitalization cardiac rehabilitation programs, where participation declines significantly after 70 years of age and non-participation rates are even lower at 80 years of age (33). Similar results have been found in lung rehabilitation post-hospitalization programs (34).

We did not find gender-related differences in participation. However, a previous study found significantly lower participation of women after a cardiac event (11). These differences should be assessed with caution because there may be age, social, or disease-related differences among participants. For instance, older women in the Basque population are as physically active as older men (35), which could account for the lack of gender-related differences in our study.

Additionally, patients who participated in the program had better nutritional status. Interestingly, nutritional status was included in the last equation of the logistic regression model as an independent predictor of participation, which indicates strength of the relationship between nutrition and participation in physical exercise. Malnutrition and poor functional performance are closely interrelated—malnutrition is associated with a higher risk of sarcopenia (36) and, consequently, poorer functional status. Malnutrition in older people is due to multiple factors (37), led by medical illnesses, mental health conditions, psychological causes, or social isolation (38). Additionally, malnutrition or risk of malnutrition in older people is directly associated with multiple negative outcomes, including increased mortality (39) longer hospital stays, and worse quality of life (40, 41).

Interventions to improve nutritional and physical status regularly include exercise. Our findings suggest that it is necessary to implement strategies to reduce barriers to developing exercise interventions and to improve older patients' participation in post-hospitalization exercise programs, especially for patients who generally refuse to participate. Further, lower participation of patients with worse nutritional status is worrying because these individuals are more prone to functional deterioration.

The strength of this study is its objective clinical measurement of reasons for non-participation in a post-hospitalization physical exercise program and its evaluation of nutritional and functional variables. To our knowledge, few studies have analyzed participation in post-hospitalization physical exercise programs in internal medicine and neurology departments. Further, those studies have usually analyzed qualitative and socioeconomic parameters for older adults' non-participation (12, 13). Nonetheless, our study also has some limitations. First, it is limited by its cross-sectional nature, which excludes any ability to determine temporality and causality. Second, because this was a secondary analysis of a trial, some variables that could be relevant have not been assessed, such as social support, transport availability, or

socio-economic status, which could have conditioned non-participation. Finally, the fact that there were only 55 participants could reduce the statistical power of the results and can also be considered a limitation of the study.

Conclusions

Participation of older patients in a post-hospitalization physical exercise program is low, especially for patients with worse nutritional status and lower accessibility at home. These findings will help develop future strategies to improve accessibility and increase older adults´ participation in physical exercise programs following hospitalization. To prevent health inequality, non-participants should have the opportunity to receive social support and nutritional intervention to increase their willingness to participate. Efforts are needed to increase participation in physical exercise programs, specifically in populations that are less prone to participate.

List Of Abbreviations

CC, Calf Circumference; MNA-SF, Mini Nutritional Assessment Short Form; MMSE, Mini Mental State Examination; PE, physical exercise; SPPB, Short Physical Performance Battery; SPMQS, Short Portable Mental Status Questionnaire.

Declarations

Ethics approval and consent to participate

The Clinical Research Ethics Committee University Hospital of Araba (2017-021) approved the study protocol, which complied with the revised ethical guidelines of the Declaration of Helsinki (2013 revision). All participants provided informed written consent before enrollment in the study

Consent for publication

Not applicable

Availability of data and materials

The database set was available to all authors of the study and are available from the corresponding author on non-commercial and reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

MU: Investigation, formal analysis, writing - original draft; **IE:** Investigation, writing - review & editing; **AB:** Conceptualization, methodology, investigation, writing - review & editing; **MA:** Investigation, writing - review & editing; **IL:** Conceptualization, methodology, writing - review & editing; **ARL:** Conceptualization, methodology, writing - review & editing; **AA:** Investigation; **JB:** Investigation; **JI:** Conceptualization, methodology, formal analysis, writing - original draft. All authors read and approved the final manuscript.

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Figures

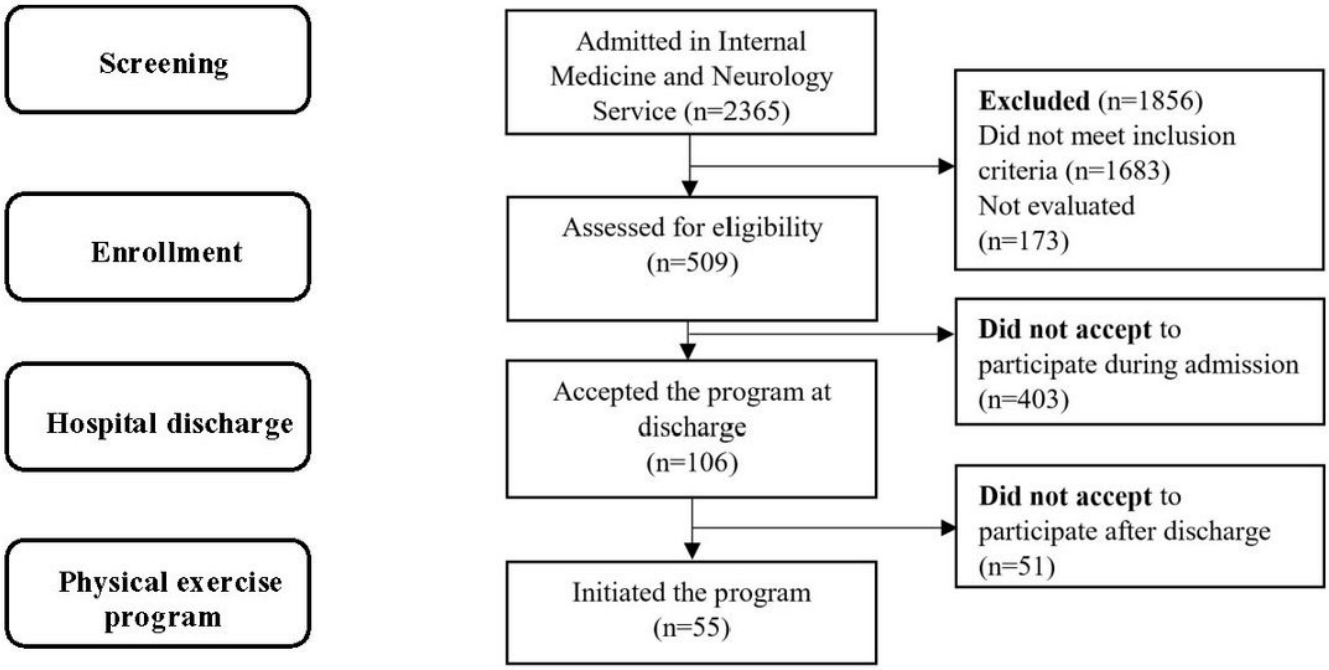

Figure 1

Study flow diagram.

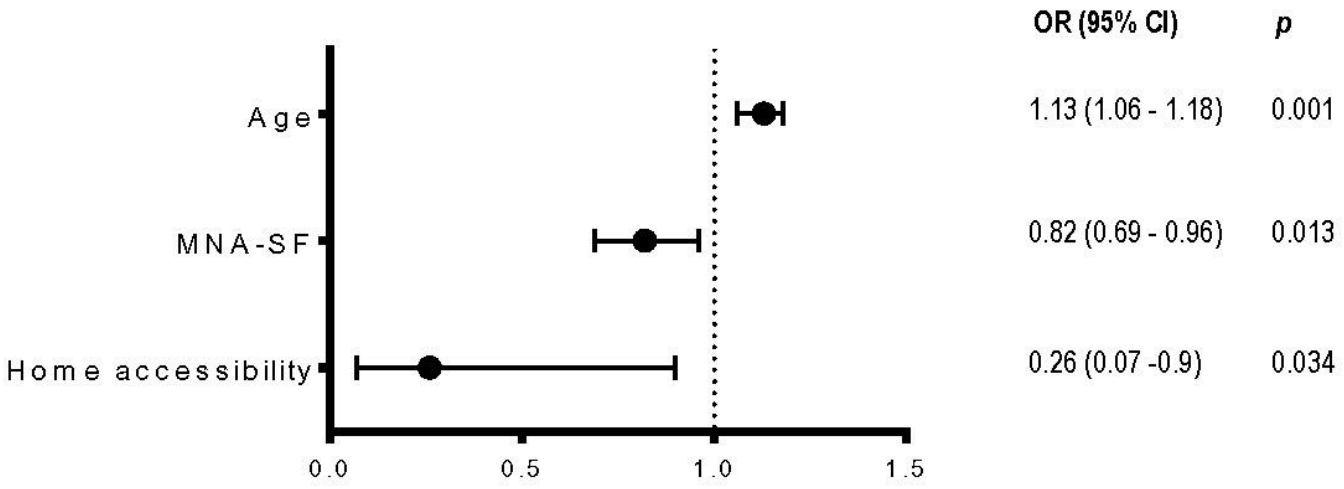

Figure 2

Multivariate logistic regression model according to participation in a post-hospitalization physical exercise program. MNA-SF, Mini Nutritional Assessment Short Form.