Use of Antipsychotics Is Negatively Associated With Muscle Strength in Older Adults With Sarcopenia After Stroke: a Retrospective Cohort Study

Eiji Kose
Teikyo University: Teikyo Daigaku
Yoshihiro Yoshimura (hanley.belfus@gmail.com)
Kumamoto Rehabilitation Byoin https://orcid.org/0000-0001-7545-4179
Hidetaka Wakabayashi
Tokyo Women's Medical University: Tokyo Joshi Ika Daigaku
Ayaka Matsumoto
Kumamoto Rehabilitation Hospital: Kumamoto Rehabilitation Byoin

Research Article

Keywords: antipsychotics, hand grip strength, rehabilitation, sarcopenia, skeletal muscle mass index

Posted Date: February 11th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1302734/v1

Abstract

Background: The use of antipsychotics have been shown to affect activities of daily living during rehabilitation, but reports regarding their effects on older patients with sarcopenia are insufficient.

Aim: To establish whether the use of antipsychotics has effects on muscle strength and muscle mass in older patients with sarcopenia undergoing convalescent rehabilitation after stroke.

Methods: This retrospective cohort study was conducted at a rehabilitation hospital between 2015 and 2020. The study outcomes included skeletal muscle mass index and hand grip strength at discharge. Multivariate analyses were used to determine whether the use of antipsychotics at admission and at 4 weeks after admission were independently associated with the study outcomes, after adjusting for potential confounders.

Results: Of the 619 stroke patients admitted, 196 (mean age 81 years; 44.4% men) had sarcopenia at admission and were included in the final analysis. The median hand grip strength and median skeletal muscle mass index values were 12.5 (5.9–17.9) kg and 5.1 (4.5–6.0) kg/m^2, respectively. In the multivariate analyses, the use of antipsychotics at 4 weeks post-admission was independently associated with hand grip strength at discharge ($\beta = -0.125$, $p = 0.008$), which was not the case when used at admission. Furthermore, the use of antipsychotics at admission and at 4 weeks after admission were not significantly associated with the skeletal muscle mass index at discharge.

Conclusions: The use of antipsychotics in older patients with sarcopenia after stroke was negatively associated with handgrip strength at discharge.

Impact Of Findings On Practice Statements

1. Our study examined the relationship of the use of antipsychotics during the first 4 weeks of hospitalization with HG and SMI at discharge in older patients with sarcopenia undergoing convalescent rehabilitation after stroke.

2. The use of antipsychotics at the first 4 weeks after admission was negatively associated with HG at discharge.

3. The use of antipsychotics during the first four weeks of hospitalization was not statistically significantly associated with SMI at discharge.

Brief Summary

Our study examined the relationship of the use of antipsychotics during the first 4 weeks of hospitalization with HG and SMI at discharge in older patients with sarcopenia undergoing convalescent rehabilitation after stroke. The use of antipsychotics at the first 4 weeks after admission was negatively

associated with HG at discharge. The use of antipsychotics during the first four weeks of hospitalization was not statistically significantly associated with SMI at discharge.

Introduction

The mainstay of treatment for sarcopenia is muscle mass and strength increase through exercise and nutritional intervention [1]. A systematic review and meta-analysis of the effects of combined exercise and nutritional therapy for sarcopenia in older people showed that this combination may have positive effects on improving walking speed within 3 months of intervention [2]. Furthermore, supplementation with whey protein, essential amino acids, and vitamin D, in conjunction with age-appropriate exercise has been reported to boost fat-free mass and strength [2]. Another report showed that leucine-enriched amino acid supplementation and low-intensity resistance training increased muscle mass, strength, and physical function in post-stroke patients with sarcopenia [3]. As is evident from the above statements, a combination of exercise and nutritional therapy is recommended to prevent and treat the sarcopenia [1].

The concept of “rehabilitation nutrition” and “rehabilitation pharmacotherapy” can be useful in rehabilitation settings [4–6]. Furthermore, with regional and age-related variations, the prevalence of sarcopenia was 1-29% in community-dwelling populations [7], approximately 50% in rehabilitation settings [8, 9]. Therefore, a combination of rehabilitation and nutritional therapy may improve the activities of daily living (ADL) in older patients with sarcopenia who present with malnutrition and functional decline. Additionally, medications management is also crucial in convalescent rehabilitation settings. Antipsychotics can affect ADL improvement during rehabilitation [10]. Typical side effects of antipsychotics include extrapyramidal symptoms, which require attention for both atypical and typical antipsychotics [11]. Extrapyramidal symptoms can cause significant impairment in motor and swallowing functions. Appropriate use of medications is also required in rehabilitation settings to ensure that adverse drug reactions do not affect rehabilitation outcomes.

However, compared to exercise and nutrition, reports on the effects of medications on sarcopenia are currently insufficient. Few studies have reported varying results in the literature, focusing on the relationship between muscle strength and medications in older people. For instance, despite the argument that there is no distinct relationship between polypharmacy and muscle strength [12], some studies have confirmed that such relationship exists [13–15]. Another report showed that the association between sarcopenia and polypharmacy varied depending on the attributes of the patients [16]. The most probable reason for these differences in results may be the differences between the studies. In reviewing these studies, it can be observed that age criteria, survey method, and the type of older adult group being studied (community-dwelling or hospitalized) differ from each other. Currently, there is no effective pharmacotherapy for sarcopenia [17]. However, from a therapeutic standpoint, it is crucial to carry out research on medications that should be noted for sarcopenia. Antipsychotics included in the Beers Criteria 2019 [18] are defined as potentially inappropriate medications (PIMs) for older adults. As mentioned above, antipsychotics affect ADL during rehabilitation [10]; however, studies conducted on their effects on older patients with sarcopenia are insufficient.

Aim

This study investigated the effects of antipsychotics on muscle strength and muscle mass in older patients with sarcopenia undergoing convalescent rehabilitation after stroke.

Ethics approval

This study was approved by the Institutional Review Board of the hospital where the study was conducted (approval no.: 177-211111). Written informed consent could not be obtained because of the constraints imposed by the retrospective study design, although the participants could withdraw from this study at any time by following an opt-out procedure. This study was conducted in accordance with the Declaration of Helsinki and ethical guidelines for medical and health research involving human subjects.

Methods

Participants and setting

This retrospective cohort study included patients admitted to a post-acute care hospital with convalescent rehabilitation wards containing 135 beds. The study period was from January 2015 to December 2020. All stroke patients who were newly admitted to the rehabilitation wards were eligible for enrollment in this study. The following exclusion criteria were applied: refusal to participate, missing data, altered consciousness (indicated by a Japan Coma Scale score of 3) [19], overt edema, altered hydration states, pacemaker implantation that might interfere with bioelectrical impedance analysis (BIA), and transfer to other hospitals or wards during rehabilitation. Patients aged ≥65 years who had sarcopenia were included in the study. The observation period for each patient corresponded with the duration of hospitalization (day of admission to day of discharge).

Data collection

Basic information including age, sex, stroke type, stroke history, days from stroke onset to ward admission, paralysis, Brunnstrom stage (BRS), home discharge status, length of stay (LOS), rehabilitation status, total number of medications, and number of patients prescribed antipsychotics were recorded between 2015 and 2020. Nutritional status was assessed using the Mini Nutritional Assessment-Short Form (MNA-SF) [20], which is a validated nutritional screening tool, body mass index (BMI), energy intake, and protein intake. Dysphagia status was evaluated by trained nurses using the Food Intake Level Scale (FILS) [21], a validated 10-point observer-rated scale for measuring swallowing status. Comorbidities using the Charlson Comorbidity Index (CCI) [22] and premorbid ADL using the modified Rankin Scale (mRS) [23] were evaluated by medical doctors. The data were recorded at the time of admission.

Within 72 hours of admission, BIA for skeletal muscle mass index (SMI), hand grip strength (HG), and functional independence measure (FIM) scores [24] for physical (FIM-motor) and cognitive function and the sum of physical and cognitive function (FIM-total) were measured. The HG of the non-dominant hand

(or in case of hemiparesis, the non-paralyzed hand) was measured using a Smedley hand dynamometer (TTM, Tokyo, Japan), and the highest of the three measurements was recorded. BIA was measured via a standard protocol using an InBody S10 instrument (InBody, Tokyo, Japan), a validated BIA instrument for which estimations of muscle mass have been reported to be minimally affected by fluid overload [25].

Antipsychotics

Antipsychotics were categorized as PIMs in most older patients based on the 2019 Beers criteria of the American Geriatric Society [18]. They include first (conventional) and second (atypical) generation antipsychotics such as chlorpromazine, tiapride, haloperidol, aripiprazole, quetiapine, risperidone, prochlorperazine, and sulpiride. Of all prescriptions, only regularly prescribed oral medications were considered, and medications prescribed for use as needed were excluded from our analysis. Medication information was investigated using medical chart reviews. Information at admission and was routinely listed by ward pharmacists engaged in inpatient pharmaceutical services. To indicate the continuation of prescriptions for a certain period, the duration of antipsychotic use was calculated from the regular prescription at 4 weeks of hospitalization.

Sarcopenia definition

Sarcopenia was diagnosed based on the criteria of the Asian Working Group for Sarcopenia 2019 (AWGS2019) [26], when both low SMI and low HG reached cut-off values specified for older Asian individuals. The SMI cutoff values used to define sarcopenia in men and women were <7 and <5.7 kg/m^2, respectively, whereas the HG cutoff values used to define sarcopenia in men and women were <28 and <18 kg, respectively.

Nutritional intakes

Energy and protein intakes were calculated by a nurse or dietitian who visually assessed the ratio of intake to the amount provided to the patient. The intake from three servings each of breakfast, lunch, and dinner (a total of nine servings) was recorded [27], and the average of each value divided by three was used as the daily intake value. In the case of enteral nutrition (EN) and parenteral nutrition (PN), the amounts of energy and protein in the first 72 h of hospitalization were recorded, and the respective values divided by 3 were used as daily intake values. If oral intake was combined with EN or PN, the respective energy and protein intakes (administered) were added. Nutrient intake was calculated by dividing each intake by the actual body weight on admission. Nutritional intake was recorded on admission.

Outcomes

The primary outcome was the HG at the time of discharge. Other outcomes included the SMI values at discharge.

Sample size calculation

The sample size was calculated using data from our previous study [28], which showed that the HG was normally distributed with a standard deviation of 11.2. A sample size of at least 64 subjects per group

would be required to reject the null hypothesis with a power of 0.9 and an alpha of 0.05 if the true difference in mean grip strength between those using fewer and those using more antipsychotics is 6.5 points [29], with the median number of antipsychotics as the cut-off value.

Statistical analysis

Results were reported as mean (standard deviation; SD) for parametric data, while medians and 25th to 75th percentiles (interquartile range [IQR]) were used to describe nonparametric data, and numbers (%) were used to describe categorical data. Statistical significance was set at $P < 0.05$. All analyses were performed using IBM SPSS version 21 (IBM, Armonk, NY, USA).

Multiple linear regression analyses were used to determine whether antipsychotics prescribed at admission and 4 weeks after admission were independently associated with HG and SMI at discharge. As potential confounders for each outcome, the baseline value (value at admission) for each outcome was included as an adjustment factor. In addition, covariates selected to adjust for bias included age, sex (male), LOS, FIM-motor, FIM-cognitive, CCI, rehabilitation, protein intake, and BRS on admission, all of which were considered to be related to muscle strength or muscle mass. To reduce bias, adjustments for common confounders were performed using a series of multivariate analysis outcomes. Multicollinearity was assessed using the variance inflation factor, with a value <3 indicating the absence of multicollinearity.

Results

During the study period, 619 stroke patients were admitted. Of these, patients with altered consciousness (n = 35), pacemaker implantation (n = 5), missing data (n = 64), those who were transferred to other hospitals or wards during rehabilitation (n = 16), and those aged <65 years (n = 138) were excluded. In total, 361 patients were further screened for eligibility, 196 of whom had sarcopenia at admission and were included in the final analysis (Figure 1). In this study, sarcopenia was diagnosed in 54.3% of older patients after stroke.

The baseline characteristics of the enrolled participants are summarized in Table 1. The included patients had a mean age of 81.0 (7.3) years, and 44.4% of the participants were males. The median number of medications used on admission was 5 (3–8). The median HG and median SMI values were 12.5 (5.9–17.9) kg and 5.1 (4.5–6.0) kg/m^2, respectively. The median FIM-motor score was 25 (range, 14–54), suggesting that many patients were physically dependent at baseline.

Table 1
Baseline characteristics of participants

	Total (N = 196)
Age, *y*	81.0 (7.3)
Sex, *male*	87 (44.4)
Stroke type	
Cerebral infarction	134 (68.4)
Cerebral hemorrhage	52 (26.5)
Subarachnoid hemorrhage	9 (4.6)
Stroke history	64 (32.7)
Premorbid mRS	1 [0 – 3]
Onset–admission days	14 [9 – 22]
Paralysis	
Right / Left / Both	85 (43.4) / 79 (40.3) / 13 (6.6)
BRS	
Upper limb / Hand–finger / Lower limb	4 [2 – 6] / 5 [2 – 6] / 5 [2 – 6]
FIM, *score*	
–Total	46 [26 – 77]
–Motor	25 [14 – 54]
–Cognitive	16 [10 – 25]
Swallowing status	
FILS, *score*	7 [3 – 9]
Dysphagia	58 (29.6)
CCI, score	3 [2 – 4]
Nutritional status	
MNA–SF, *score*	5 [3 – 7]
BMI, kg/m^2	20.6 [18.5 – 22.6]
Energy intake, *kcal/kg/day*	28.8 [24.5 – 34.4]
Protein intake, *g/kg/day*	1.1 [0.9 – 1.3]

	Total (N = 196)
Muscle–related variables	
HG, *kg*	12.5 [5.9 – 17.9]
SMI, kg/m^2	5.1 [4.5 – 6.0]
Laboratory data	
Alb, *g/dL*	3.4 (0.5)
CRP, *g/dL*	1.4 (2.5)
Hb, *mg/dL*	12.7 (1.7)
Home discharge	99 (50.5)
Length of stay, *days*	104 [70 – 144]
Rehabilitation [a], *units/day*	8.1 [7.2 – 8.5]
Number of total medications	5 [3 – 8]
Number of patients prescribed antipsychotics	
On admission	16 (8.2)
4w after admission	19 (9.7)

The number of antipsychotics used at admission and at 4 weeks after admission are summarized in Table 2. Fourteen patients (6.1%) were using one medication at admission, which increased to 18 patients (9.2%) after 4 weeks; two patients (1.0%) were using two medications at admission, which decreased to one patient (0.5%) after 4 weeks. However, there was no statistically significant difference between the two groups.

Table 2
Number of antipsychotics prescribed at admission and 4w after admission

Drug	At admission (n = 196)	4w after admission (n = 196)	P value*
Antipsychotics			
1 drug	14 (6.1)	18 (9.2)	0.268
2 drugs	2 (1.0)	1 (0.5)	
>2 drugs	0 (0.0)	0 (0.0)	

Multivariate linear regression analyses of the HG at discharge are shown in Table 3. There was no multicollinearity between the variables. The results showed that the use of antipsychotics 4 weeks post-admission was independently associated with HG at discharge (β = −0.125, p = 0.008), SMI (β = 0.204, p = 0.004), HG (β = 0.581, p = < 0.001), FIM-cognitive (β = 0.140, p = 0.035), LOS (β = 0.184, p = 0.001), and age (β = −0.105, p = 0.029). However, the use of antipsychotics at admission was not significantly associated with HG at discharge.

Table 3
Multivariate linear regression analysis of HG at hospital discharge among older inpatients with sarcopenia after stroke

	HG at discharge			
	β	P-value	β	P-value
Age	−0.102	0.037	−0.105	0.029
Sex (male)	0.081	0.239	0.071	0.289
LOS	0.187	0.001	0.184	0.001
FIM−motor	−0.047	0.585	−0.093	0.276
FIM−cognitive	0.133	0.050	0.140	0.035
CCI	−0.015	0.751	−0.010	0.837
Rehabilitation	0.007	0.879	0.021	0.664
HG	0.596	< 0.001	0.581	0.000
SMI	0.181	0.012	0.204	0.004
Protein intake	−0.094	0.063	−0.079	0.111
BRS−lower ext.	0.077	0.252	0.108	0.105
Antipsychotics on admission	−0.027	0.559	–	–
Antipsychotics 4w after admission	–	–	−0.125	0.008

Multivariate linear regression analyses of the SMI at discharge are shown in Table 4. There was no multicollinearity between the variables. The results showed that the use of antipsychotics at admission and 4 weeks after admission was not significantly associated with SMI at discharge.

Table 4
Multivariate linear regression analysis of SMI at hospital discharge among older inpatients with sarcopenia after stroke

	SMI at discharge			
	β	P-value	β	P-value
Age	−0.092	0.069	−0.095	0.060
Sex (male)	0.004	0.957	0.001	0.985
LOS	0.036	0.567	0.031	0.618
FIM−motor	−0.001	0.995	−0.015	0.868
FIM−cognitive	0.030	0.659	0.033	0.629
CCI	0.045	0.364	0.048	0.329
Rehabilitation	0.010	0.845	0.007	0.879
HG	0.006	0.928	0.005	0.946
SMI	0.833	< 0.001	0.835	< 0.001
Protein intake	−0.061	0.254	−0.054	0.304
BRS−lower ext.	0.035	0.613	0.042	0.553
Antipsychotics on admission	0.033	0.508	–	–
Antipsychotics 4w after admission	–	–	0.008	0.868

Discussion

Our study examined the relationship of the use of antipsychotics during the first 4 weeks of hospitalization with HG and SMI at discharge in older patients with sarcopenia undergoing convalescent rehabilitation after stroke. The most important finding of this study was that the use of antipsychotics at the first 4 weeks after admission was negatively associated with HG at discharge. The second most important finding was that the use of antipsychotics during the first four weeks of hospitalization was not statistically significantly associated with SMI at discharge.

As mentioned, the association between medication use and muscle strength has already been reported [12–16]. However, our study differs from many other studies in that we focused on antipsychotics. Of note, our study is the first to demonstrate that the use of antipsychotics is negatively associated with strength such as HG. Furthermore, the associations shown in our study between age, antipsychotic use, LOS, ADL, rehabilitation, protein intake, and CCI indicate how interwoven older specific clinical conditions are. The mainstay of treatment for sarcopenia is muscle mass and strength increase through exercise

and nutritional interventions. However, based on our results, it is necessary to consider not only exercise and nutritional interventions, but also the effects of medications, especially antipsychotics.

The use of antipsychotics at the first 4 weeks after admission was not statistically significantly associated with SMI at discharge. However, in some cases, muscle mass alone is not sufficient for understanding the condition of muscle function. In other words, muscle mass does not necessarily correlate with muscle strength, and high risk of functional impairment is associated with weak muscle strength, even if the muscle mass is high. Morphological and functional factors are involved in the exertion of muscle strength. The morphological aspect is the cross-sectional area of muscle fibers and the muscle fiber composition. Muscle strength exertion is proportional to the cross-sectional area of muscle fibers. The central nervous system plays an important role in the function aspect. In other words, when neural activity in the brain is reduced and insufficient information is obtained from the central nervous system, it becomes difficult to exert muscle strength properly. Antipsychotics have an inhibitory effect on the central nervous system by blocking dopamine receptors. Because they suppress the action of dopamine, they also affect motor function. When changes occur in the central nervous system, muscle strength becomes weaker, even if muscle mass is maintained, and the quality of functional muscles is diminished. As such, it is conceivable that interventions to assess muscle strength in addition to muscle mass will lead to improvements in functional prognosis, quality of life, and prevention of adverse events.

The treatment of sarcopenia in rehabilitation settings, including rehabilitation nutrition [4], and rehabilitation pharmacotherapy [5, 6, 30], should be comprehensive. Sarcopenia can be caused by a variety of factors, including aging, low activity level, and poor nutritional status [31]. However, our results suggest that the use of antipsychotics can also be a cause. Overall, a multifaceted approach from the perspectives of rehabilitation nutrition [4] and rehabilitation pharmacotherapy [5, 6] is essential for the prevention or treatment of sarcopenia. The usefulness of rehabilitation nutrition [4] has been established for patients with sarcopenia undergoing rehabilitation. However, evidence regarding rehabilitation pharmacotherapy is insufficient. Our results may provide an opportunity to review the administration of antipsychotics in patients with sarcopenia. It is conceivable that multidisciplinary implementation of nutritional therapy and exercise therapy together with the results of this study will advance the treatment of sarcopenia.

This study has several limitations. First, this was a retrospective cohort study conducted at a single hospital in Japan, which limits its generalizability. However, our results may be useful in an aging population, such as Japan, or in populations with similar prescribing trends. Second, the effects of medications other than antipsychotics were not considered. Finally, electronic medical charts-recorded information was used to capture data; it could not be verified whether subjects used the dispensed medicine. Therefore, future validation in a multicenter, prospective cohort study that takes these limitations into account is desirable.

In conclusion, the use of antipsychotics 4 weeks after admission in older patients with sarcopenia undergoing convalescent rehabilitation after stroke was negatively associated with HG at discharge, but it

was not significantly associated with SMI. The use of antipsychotics should be avoided as much as possible in older patients with sarcopenia undergoing convalescent rehabilitation after stroke.

Declarations

Acknowledgement

The authors appreciate all the patients who kindly participated in the study, as well as the clinical assistance of Kumamoto Rehabilitation Hospital.

Disclosure statement

The authors declare that there no conflicts of interest regarding the publication of this article.

Funding sources

This research did not receive any funding from agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

None

References

1. Arai H, Wakabayashi H, Yoshimura Y, et al. Chapter 4 Treatment of sarcopenia. *Geriatr Gerontol Int*. 2018; **18**: 28–44.
2. Yoshimura Y, Wakabayashi H, Yamada M, et al. Interventions for Treating Sarcopenia: A Systematic Review and Meta-Analysis of Randomized Controlled Studies. *J Am Med Dir Assoc*. 2017; **18**: 553.e1–553.e16.
3. Yoshimura Y, Bise T, Shimazu S, et al. Effects of a leucine-enriched amino acid supplement on muscle mass, muscle strength, and physical function in post-stroke patients with sarcopenia: A randomized controlled trial. *Nutrition*. 2019; **58** :1–6.
4. Wakabayashi H, Sakuma K. Rehabilitation nutrition for sarcopenia with disability: a combination of both rehabilitation and nutrition care management. *J Cachexia Sarcopenia Muscle*. 2014; **5**: 269–277.
5. Wakabayashi H. Rehabilitation pharmacotherapy: A combination of rehabilitation and pharmacotherapy. *J Gen Fam Med*. 2018; **19**: 43–44.
6. Kose E, Wakabayashi H. Rehabilitation pharmacotherapy: A scoping review. *Geriatr Gerontol Int*. 2020; **20**: 655–663.
7. Cruz-Jentoft AJ, Landi F, Schneider SM, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and

IWGS). *Age Ageing.* 2014; **43**: 748–759.

8. Matsushita T, Nishioka S, Taguchi S, et al. Sarcopenia as a predictor of activities of daily living capability in stroke patients undergoing rehabilitation. *Geriatr Gerontol Int*. 2019; **19**: 1124–1128.
9. Yoshimura Y, Wakabayashi H, Bise T, et al. Prevalence of sarcopenia and its association with activities of daily living and dysphagia in convalescent rehabilitation ward inpatients. *Clin Nutr*. 2018; **37**: 2022–2028.
10. Nakamichi M, Wakabayashi H, Nishioka S, et al. Influence of Antipsychotics on Functional Prognosis after Geriatric Hip Fracture. *J Nutr Health Aging*. 2019; **23**: 381–385.
11. Kose E, Uno K, Hayashi H. Evaluation of the Expression Profile of Extrapyramidal Symptoms Due to Antipsychotics by Data Mining of Japanese Adverse Drug Event Report (JADER) Database. *Yakugaku Zasshi*. 2017; **137**: 111–120.
12. Volaklis KA, Thorand B, Peters A, et al. Physical activity, muscular strength, and polypharmacy among older multimorbid persons: Results from the KORA-Age study. *Scand J Med Sci Sports*. 2018; **28**: 604–612.
13. Rawle MJ, Cooper R, Kuh D, et al. Associations Between Polypharmacy and Cognitive and Physical Capability: A British Birth Cohort Study. *J Am Geriatr Soc*. 2018; **66**: 916–923.
14. Eyigor S, Kutsal G, Toraman F, et al. Polypharmacy, Physical and Nutritional Status, and Depression in the Elderly: Do Polypharmacy Deserve Some Credits in These Problems? *Exp Aging Res*. 2021; **47**: 79–91.
15. Soytas RB, Arman P, Suzan V, et al. Association between anticholinergic drug burden with sarcopenia, anthropometric measurements, and comprehensive geriatric assessment parameters in older adults. *Arch Gerontol Geriatr*. 2022. in press.
16. Panaabc A, Sourtziab P, Kalokairinoua A, et al. Sarcopenia and polypharmacy among older adults: A scoping review of the literature. *Arch Gerontol Geriatr*. 2022; **98**: 104520.
17. Juergen Bauer, John E Morley, Schols AMWJ, et al. Sarcopenia: A Time for Action. An SCWD Position Paper. *J Cachexia Sarcopenia Muscle*. 2019; **10**: 956–961.
18. By the 2019 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2019 Updated AGS Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults: 2019 AGS BEERS CRITERIA® UPDATE EXPERT PANEL. *J Am Geriatr Soc*. 2019; **67**: 674–694.
19. Shigematsu K, Nakano H, Watanabe, Y. The Eye Response Test Alone Is Sufficient to Predict Stroke Outcome–Reintroduction of Japan Coma Scale: A Cohort Study. *BMJ Open.* 2013: **3**: e002736.
20. Kaiser M, Bauer J, Ramsch C, et al. Validation of the Mini Nutritional Assessment Short-Form (MNA-SF): A practical tool for identification of nutritional status. *J Nutr Health Aging*. 2009; **13**: 782–788.
21. Kunieda K, Ohno T, Fujishima I, et al. Reliability and Validity of a Tool to Measure the Severity of Dysphagia: The Food Intake LEVEL Scale. *J Pain Symptom Manage.* 2013; **46**: 201–206.
22. Charlson ME, Pompei P, Ales KL, et al. A New Method of Classifying Prognostic Comorbidity in Longitudinal Studies: Development and Validation. *J Chronic Dis.* 1987; **40**: 373–383.

23. Banks JL, Marotta CA. Outcomes Validity and Reliability of the Modified Rankin Scale: Implications for Stroke Clinical Trials: A Literature Review and Synthesis. *Stroke* 2007; **38**: 1091–1096.
24. Ottenbacher KJ, Hsu Y, Granger CV, et al. The Reliability of the Functional Independence Measure: A Quantitative Review. *Arch Phys Med Rehabil.* 1996; **77**: 1226–1232.
25. Kaido T, Uemoto S. Direct Segmental Multi-Frequency Bioelectrical Impedance Analysis Is Useful to Evaluate Sarcopenia. *Am J Transplant.* 2013; **13:** 2506–2507.
26. Chen LK, Woo J. Assantachai P, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. *J Am Med Dir Assoc.* 2020; **21**: 300–307.e2.
27. Sawaya AL, Tucker K, Tsay R, et al. Evaluation of Four Methods for Determining Energy Intake in Young and Older Women: Comparison with Doubly Labeled Water Measurements of Total Energy Expenditure. *Am J Clin Nutr.* 1996; **63**: 491–499.
28. Yoshimura Y, Wakabayashi H, Nagano F, et al. Low Hemoglobin Levels are Associated with Sarcopenia, Dysphagia, and Adverse Rehabilitation Outcomes After Stroke. *J Stroke Cerebrovasc Dis*. 2020; **29**: 105405.
29. Bohannon RW. Minimal clinically important difference for grip strength: a systematic review. *J. Phys. Ther. Sci*. 2019; **31**: 75–78.
30. Matsumoto A, Yoshimura Y, Wakabayashi H, et al. Deprescribing Leads to Improved Energy Intake among Hospitalized Older Sarcopenic Adults with Polypharmacy after Stroke. *Nutrients*. 2022; **14**: 443. https://doi.org/10.3390/nu14030443
31. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, et al. European Working Group on Sarcopenia in Older People: Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. *Age Ageing*. 2010; **39**: 412–423.

Figures

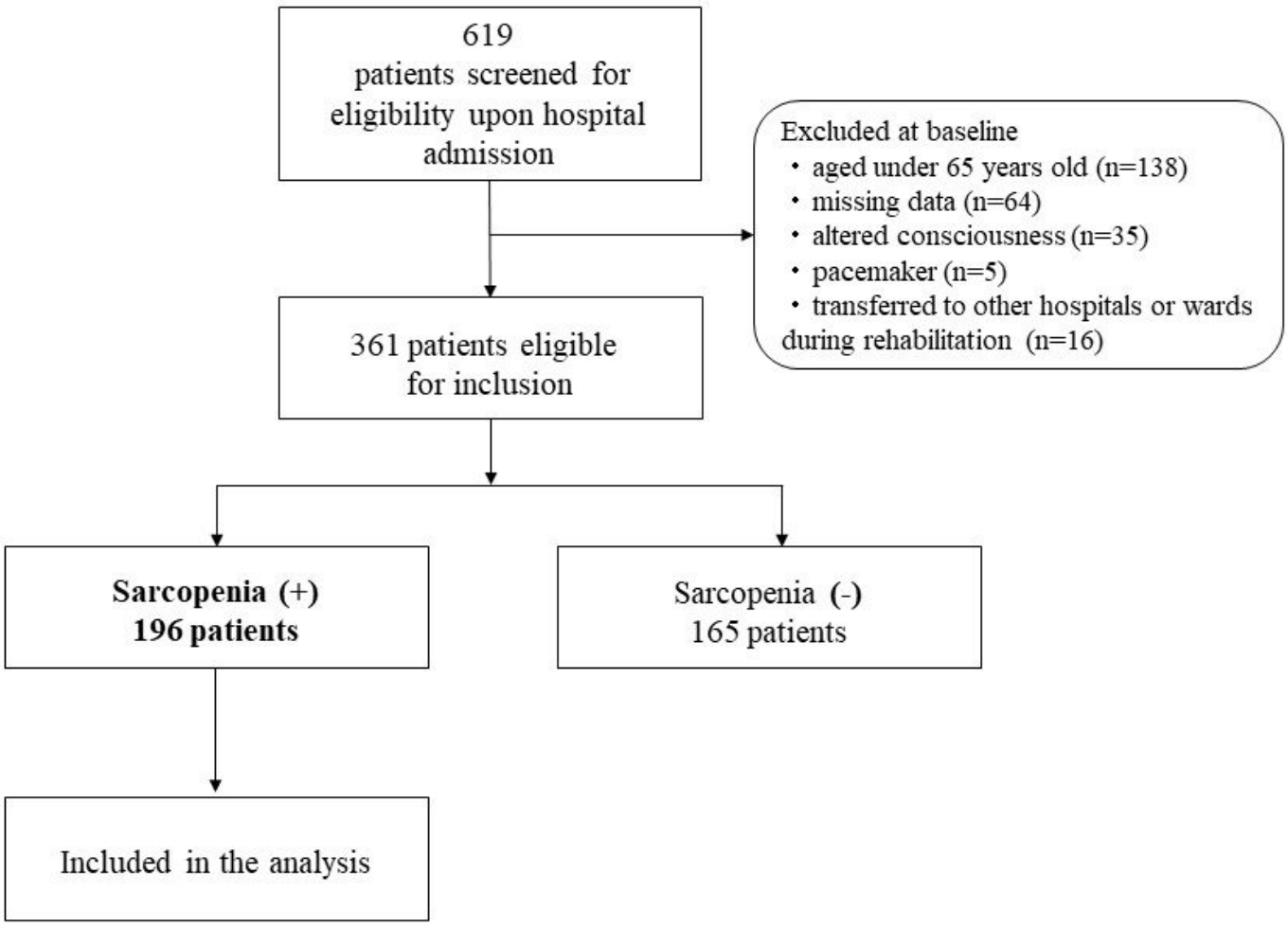

Figure 1

Flowchart of participant screening, inclusion criteria, and follow-up.