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RESEARCH ARTICLE

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Functional and emotional impact of COVID-19 lockdown on older adults with sarcopenia living in a nursing home: A 15-month follow-up

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Abstract

This study aimed to detect the functional and emotional impact of COVID-19 lockdown on institutionalized older adults with sarcopenia during a 15-month follow-up. A prospective longitudinal cohort study was conducted in a nursing home. Participants were screened for sarcopenia, and those with a score of ≥4 points according to SARC-F questionnaire were included. Assessments were performed pre-lockdown (T1), 12 months (T2) after, and at a 15-month follow-up (T3). Functional measurements included chair stand test, handgrip, biceps brachii and quadriceps femoris strengths, appendicular skeletal mass, gait speed, Short Physical Performance Battery, and Timed Up-and-Go test. Emotional assessments included Short-Form Health Survey, Geriatric Depression Scale—Short Form, and the Mini-Mental State Examination. The analyzed sample showed a reduction in bicep strength, and other upper and lower limb strength variables showed a decreasing trend with no changes regarding muscle mass. Physical performance showed a change, specifically a deterioration in the subtest related to balance. Cognitive and emotional components were affected and quality of life was decreased. It is of paramount importance to focus on sarcopenic older adults since their characteristics can deteriorate when isolation measures are conducted.

KEYWORDS

COVID-19 lockdown, emotional aspects, functionality, institutionalized older adults, sarcopenia

Key points

- Institutionalized older adults with sarcopenia in the region of Valencia, Spain, had not been previously studied in either the physical or emotional sphere during the COVID-19 lockdown with a 15-month follow-up.
- In the 15-month follow-up, there was an evident decline in muscle strength, particularly biceps brachii strength and Short Physical Performance Battery performance, with no changes regarding muscle mass.

- There was an increase in cognitive impairment and depression symptoms in the 15-month follow-up.

1 | INTRODUCTION

Sarcopenia has been defined as a progressive and generalized skeletal muscle disorder, associated with an increased likelihood of adverse outcomes such as falls, fractures, physical disability, and mortality (Cruz-Jentoft et al., 2019). Sarcopenia has a high prevalence among older adults, ranging between 17.7% and 73.3% among institutionalized older adults (Rodríguez-Rejón et al., 2019). This may be related to the association of institutionalized older adults with sedentary behavior and a higher prevalence of chronic diseases, which therefore causes them to be the frailest of the population (Crocker et al., 2013).

In March 2020, the World Health Organization declared the outbreak of the coronavirus disease 2019 (COVID-19) as a pandemic. Physiological changes related to aging, comorbidities, and geriatric syndromes were associated with a higher risk of negative prognosis when infected with COVID-19, which was increased in nursing homes (McMichael et al., 2020). To slow the spread of the infection in nursing homes, social isolation measures were adopted, and physical activities carried out collectively were not allowed.

1.1 | Background

Previous studies have focused on community living older adults; they have reported that these measures, although necessary to stop the COVID-19 spread, have resulted in an increase in sedentary behavior and a reduction in physical activity (Ammar et al., 2020), which are known to be associated with muscle mass loss (Breen et al., 2013). Isolation and confinement have also had emotional consequences such as an increase in stress and anxiety levels (Lei et al., 2020), as well as depression among older adults (Meng et al., 2020).

Although some studies have analyzed the effects of lockdown on institutionalized older adults, the focus has mainly been on the emotional aspects (Ammar et al., 2020; Angevaare et al., 2022; Savci et al., 2021) and well-being (Levere et al., 2021). Among institutionalized older adults, recent research has also observed a significant functional, cognitive, and nutritional decline after the first wave of COVID-19 (Pérez-Rodríguez et al., 2021). Moreover, in institutionalized older adults, several alterations to frailty markers have been observed, such as the worsening of the nutritional status, the decrease in physical performance, and an increased risk of screening positive for sarcopenia (De Souza Oliveira et al., 2023). These studies showed that lockdown had substantial impacts on nursing home residents, adversely affecting the physical, functional, and emotional well-being of residents.

However, to the best of our knowledge, no previous study has focused on tracking nursing home residents longitudinally for over a year regarding all sarcopenia variables and how they could change due to lockdown. Therefore, it is necessary to evaluate the impact of confinement on older adults with sarcopenia who are more vulnerable to other comorbidities, as well as to quantify it in both the physical and emotional spheres in the long term. We hypothesized that lockdown would be associated with a decline in functional capacity and emotional impairment in institutionalized older adults with sarcopenia.

1.2 | Aim

The aim of this study was to detect the functional and emotional impact of the COVID-19 lockdown restrictions on institutionalized older adults with sarcopenia during a 15-month follow-up. The second objective of the study was to analyze the changes regarding the sarcopenia classification of the participants within a 15-month period.

2 | METHODS

2.1 | Study design

This is a prospective longitudinal cohort study. It was carried out in a nursing home in the province of Valencia, Spain, between January 2020 and March 2021. This study is related to a previous cross-sectional study registered in the ClinicalTrials.gov database (ID: NCT03832608).

2.2 | Ethics considerations

This study was approved by the Ethics Committee for Human Research of the University of Valencia (H1542733812827) and was conducted in accordance with the Declaration of Helsinki. To ensure protection of the rights of the potential participants, prior to the start of the study, the center's psychologist, together with the researcher, explained the study to the participants. All the participants were informed in person, both in writing and orally, to ensure that they understood each of the tests they would undergo and the purpose of the study. Finally, informed consent was obtained from the participants.

2.3 | Setting and participants

The nursing home was a skilled nursing care facility, with a total of 74 beds. The sample included institutionalized men and women over 65 years, who screened positive for sarcopenia using the SARC-F questionnaire (score ≥4 points) (Malmstrom et al., 2016). Exclusion criteria included older adults with a diagnosis of Alzheimer's and/or dementia, with Mini-Mental State Examination score of <18 points (severe cognitive impairment) (Ghisla et al., 2007), being in an acute process of any disease, and having suffered any hospital admission in the previous month.

2.4 | Measures

All participants undertook face-to-face assessments. The Mini-Mental State Examination, number of medications taken daily, number of hospitalizations, number of falls, Barthel Index, the Geriatric Depression Scale—Short Form, and the Mini Nutritional Assessment-Short Form (MNA-SF) data were retrieved from the institution database.

Social and anthropometric characteristics: (1) age (years); (2) sex (men/women); (3) weight (kg) assessed with a Tanita BC 601 scale (TANITA Ltd., Netherlands); (4) height (cm); and (5) body mass index (BMI, kg/m^2).

Clinical characteristics:

1. Number of medications taken daily, considering polypharmacy as the routine use of five or more medications.
2. Number of hospitalizations in the last year.
3. The Barthel Index, which includes 10 items related to activities of daily living: feeding, grooming, bathing, dressing, bowel and bladder care, toilet use, ambulation, transfers, and stair climbing. The score ranges from 0 to 100, where values below 20 indicate total dependence for activities of daily living, values between 21 and 60 indicate severe dependence, values between 61 and 90 indicate moderate dependence, values between 91 and 99 indicate mild dependence, and a score of 100 points indicates independence (Shah et al., 1989). The BI has shown adequate internal consistency ($\alpha = 0.70$) (González et al., 2018).
4. Abbreviated Charlson's comorbidity index, which includes eight medical conditions (cerebral vascular disease, diabetes, chronic obstructive pulmonary disease, heart failure/ischemic heart disease, dementia, peripheral arterial disease, chronic kidney failure [dialysis], and cancer) scored between 0 and 10. An absence of comorbidity is indicated by a score of 0–1 points, low comorbidity corresponds to a score of 2, and high comorbidity is defined as a score of ≥3 points (Berkman et al., 1992). This instrument has a similar short-term prognostic probability to the long version (Jiménez, 2007).
5. Nutritional status was assessed using the MNA-SF, a validated tool for detecting malnourished people or those at risk of malnutrition among older adults (Kaiser et al., 2009). It comprises five questions related to decreased food intake, recent unintentional weight loss, current mobility, stress or acute illness, and presence of dementia or depression, to which the BMI calculation or the measurement of the calf circumference at the widest point is added. In this study, the BMI was used since all the assessed participants were able to stand. The total score of the MNA-SF ranges from 0 to 14 points and classifies nutritional status as normal (12–14 score), risk of malnutrition (8–11 score), and malnutrition (0–7 score) (Vellas et al., 1999). In relation to MNA, it has a sensitivity of 81.4% and a specificity of 92.7%, as well as a strong positive predictive value (De La Montana & Miguez, 2011; Garcia-Meseguer & Serrano-Urrea, 2013).
6. Frailty is measured by Fried Phenotype (Fried et al., 2001), which includes five clinical criteria: (1) involuntary weight loss; (2) fatigue; (3) low level of physical activity; (4) muscle weakness (grip strength); and (5) slow gait. The presence of any of these criteria scored 1 point, with the total score ranging from 0 to 5 points. Participants were classified as robust (0 points), pre-fragile (1–2 points), and fragile (3 points). It has good reliability and prognostic validity (Acosta-Benito & Martín-Lesende, 2022).

Functional and physical characteristics:

Sarcopenia classification: The European Working Group in Sarcopenia in Older People 2 algorithm was conducted (Cruz-Jentoft et al., 2019). This algorithm is an international guideline widely used to define and diagnose sarcopenia (Cruz-Jentoft et al., 2019; Witham & Stott, 2019). It includes multiple measures, which begin with an initial screening, followed by an assessment of low muscle strength as a key characteristic of probable sarcopenia. Low muscle quantity is then used to confirm the diagnosis, and physical performance is evaluated to determine the severity of sarcopenia (Cruz-Jentoft et al., 2019). Participants were screened for sarcopenia with a score of ≥4 points in the SARC-F questionnaire (Malmstrom et al., 2016). They had probable sarcopenia with low muscle strength assessed by the chair stand test (cutoff point >15 s for five rises) (Studenski et al., 2014). They were diagnosed with sarcopenia when low muscle quantity was also detected. The appendicular skeletal muscle mass was measured with bioimpedance analysis using the Bodystat® 1500MDD (Bodystat Ltd., Douglas, UK) and Sergi's bioimpedance analysis equation (Sergi et al., 2015). The appendicular skeletal muscle mass cutoff points for low mass were <20 kg for men and <15 kg for women (Studenski et al., 2014). They had severe sarcopenia when low physical performance was added, measured by gait speed (cutoff point was <0.8 m/s) (Cruz-Jentoft et al., 2010). The chair stand test and the appendicular skeletal muscle mass have been shown to detect more cases of probable and confirmed sarcopenia, respectively (Arnal-Gómez et al., 2021), and gait speed is considered a highly reliable test for sarcopenia (Bruyère et al., 2016). In addition, the use of equipment-free tests such as the chair stand test and gait speed facilitate diagnosis in clinical settings. These tests require no equipment, are simple and quick to perform, and can be performed by different health professionals after a period of training.

Muscle strength: Handgrip strength (kg) measured by Jamar Plus +® device (Patterson Medical, Sammons Preston, Bolingbrook, IL, USA) was assessed bilaterally. Three measurements were assessed, with the highest value being taken for analysis (Roberts et al., 2011). Biceps brachii and quadriceps femoris strengths (kg) were evaluated in the dominant limb using a dynamometry Lafayette Manual Muscle Tester device (Lafayette, IN, USA). Three measurements were taken

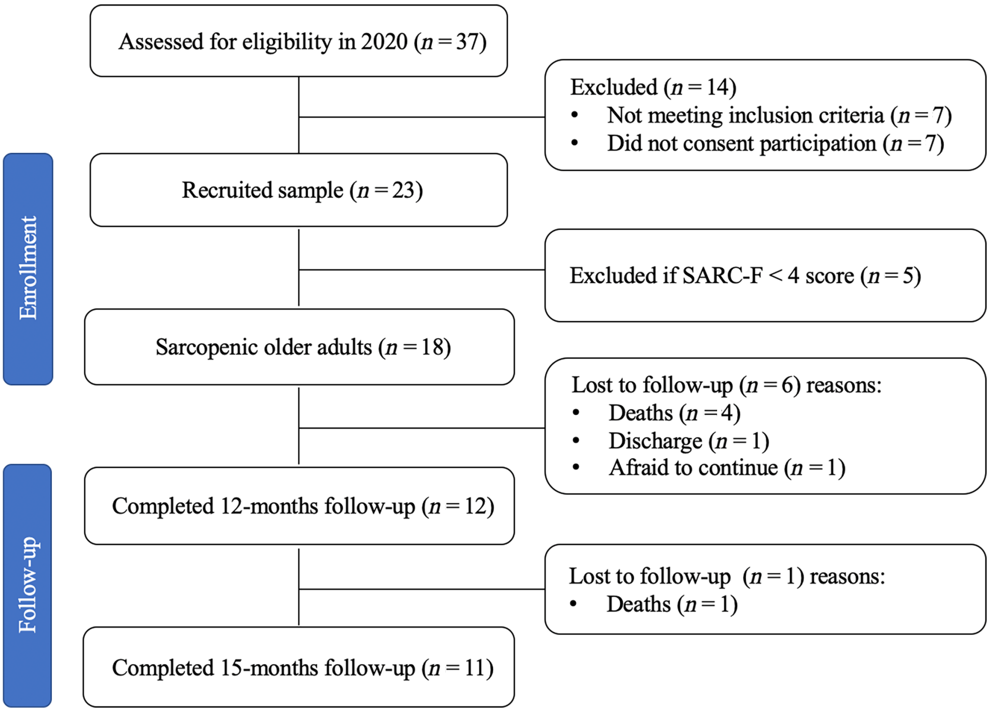

FIGURE 1 Flow diagram: Enrolment and follow-up periods.

for each strength variable, with the highest value being taken for analysis (Bohannon, 1986; Stark et al., 2011).

Muscle quantity: From the appendicular skeletal muscle mass value, two new variables were calculated following previous sarcopenia-related literature: (1) appendicular skeletal muscle mass/height squared (kg/m^2), with cutoff points for low mass <7.0 kg/m^2 and <5.5 kg/m^2, for men and women, respectively (Cruz-Jentoft et al., 2019); and (2) appendicular skeletal muscle mass/body mass index (kg/kg/m^2) (Kim et al., 2016).

Physical performance: (1) Short Physical Performance Battery (0–12 score), which has balance, walking, and rising subtests (Guralnik et al., 1994), with ≤8 points being the cutoff (Pavasini et al., 2016). Also, (2) the Timed Up-and-Go test (s), with ≥20 s being the cutoff (Podsiadlo & Richardson, 1991).

Emotional and cognitive characteristics: (1) health-related quality of life was assessed with the eight-item Short-Form Health Survey (SF-8). The score ranges from 0 to 40 points, with a higher score indicating better quality of life (Tomás et al., 2018). The SF-8 is a feasible, reliable, valid, and sensitive instrument to assess health-related quality of life. It has been shown to have high internal consistency ($\alpha = 0.92$) (Vallès et al., 2010). (2) The Geriatric Depression Scale—Short Form was implemented. It comprises 15 questions (yes/no answer) and its score ranges from 0 to 15 points. The literature recommends using scores of ≥5 as a cutoff point to consider the possible existence of depressive symptoms (Friedman et al., 2005; Martínez de la Iglesia et al., 2002). This instrument has shown moderate reliability, moderate internal consistency ($\alpha = 0.749$), 89.5% sensitivity, and 65.3% specificity (Friedman et al., 2005). (3) The Mini-Mental State Examination was used to assess cognitive characteristics (Lobo et al., 1999). It explores various cognitive functions: (1) temporal–spatial orientation; (2) immediate and long-term memory; (3) attention; (4) calculation; (5) language; (6) abstract reasoning; and (7) praxis (Calero-García & Navarro-González, 2006). The total score is between 0 and 35 points. A score of <18 corresponds to severe cognitive impairment (Black et al., 1999; Ghisla et al., 2007; Müller-Thomsen et al., 2005). Regarding its validity in the institutionalized population, the MMSE has a sensitivity of 73.6% and a specificity of 84.6% (Lobo et al., 1999).

2.5 | Time point measurements

The time points for data collection depended on the pandemic process and were conducted as follows: T1 or pre-lockdown (January 2020), T2 or 12-month follow-up (January 2021), and T3 or 15-month follow-up (March 2021). The assessor who conducted the assessments was the nursing home physical therapist. Thus, monitoring these vulnerable people who had a high risk of contagion was allowed under conditions of confinement.

2.6 | Lockdown description

In March 2020, under the state of alarm, nursing home lockdown employed the isolation of older adults in their rooms and stopped carrying out the weekly activity program: physical activities, cognitive stimulation, or activities of daily living (ADL) in the common areas (Orden SND/265/2020, de 19 de marzo, 2020). Between June and July 2020, movement was allowed under safe conditions. In this 'new normal', movement around the common areas was allowed, and

TABLE 1 Baseline characteristics for all the samples and by sex: median (minimum–maximum) and number of cases (percentages).

Variables	Total ($n = 18$)	Men ($n = 6$, 33.3%)	Women ($n = 12$, 66.7%)	p-value[a,b]
Anthropometric characteristics				
Age (years)	86.5 (66–93)	78.5 (76.0–89.0)	88.5 (66.0–93.0)	0.102
Weight (kg)	65.7 (51.0–94.3)	78.8 (57.8–81.3)	62.4 (51.0–94.3)	0.250
Height (cm)	150 (141–169)	159.0 (150.0–169.0)	148.3 (141.0–157.0)	**0.002**
BMI (kg/m^2)	28.1 (22.6–44.9)	28.0 (24.5–35.8)	28.1 (22.6–44.9)	0.682
Clinical characteristics				
Medication (n)	10 (6–18)	11 (7–18)	9.5 (6–12)	0.102
Hospitalizations (n)	0 (0–2)	0 (0–2)	0 (0–1)	0.385
Barthel Index (0–100 score)	67.5 (15–90)	85 (45–90)	65 (15–90)	0.385
Ab-Charlson (0–10 score)	1.5 (0–4)	3 (1–4)	1 (0–3)	0.083
MNA (0–14 score)	12.0 (8.0–14.0)	9 (8–13)	12 (9–14)	0.053
Risk of malnutrition (MNA)				
Normal (12–14)	11 (61.1)	2 (33.3)	9 (75)	0.087
In risk (8–11)	7 (38.9)	4 (66.7)	3 (25)	
Malnutrition (0–7)	0 (0)	0 (0)	0 (0)	
Fried phenotype score	3 (1–4)	3 (2–4)	3 (1–4)	0.553
Frailty-Fried phenotype				
Yes (≥3 score)	12 (66.7)	5 (83.3)	7 (58.4)	0.289
No (<3 score)	6 (33.3)	1 (16.7)	5 (41.6)	
Functional and physical characteristics				
Sarcopenia classification				
SARC-F (0–10 score)	5.5 (4.0–9.0)	5.5 (4–8)	5.5 (4–9)	1.000
Chair stand test (s)	20.6 (15.8–34.19	20.9 (15.8–34.1)	20.1 (15.8–26.5)	0.710
ASM (kg)	15.0 (11.3–19.8)	18.2 (15.1–19.8)	14.3 (11.3–16.92)	**0.014**
Gait speed (m/s)	0.4 (0.1–0.9)	0.4 (0.3–0.9)	0.4 (0.1–0.6)	0.892
Other variables				
Handgrip strength (kg)	19.5 (7.8–28.8)	23.3 (17.4–28.8)	18.2 (7.8–23.5)	**0.032**
Biceps brachii strength (kg)	10.6 (6.3–17.6)	13.5 (8.5–17.6)	9.1 (6.3–15.0)	0.053
Quadriceps strength (kg)	13.6 (6.8–27.7)	18.8 (11.0–27.7)	10.0 (6.8–14.6)	**0.013**
ASM/heigth^2 (kg/m^2)	6.4 (5.0–8.5)	6.9 (6.3–8.5)	6.1 (5.0–8.4)	0.160
ASM/BMI (kg/kg/m^2)	0.5 (0.4–0.7)	0.6 (0.5–0.7)	0.5 (0.4–0.6)	**0.001**
SPPB (0–12 score)	4 (1–7)	4.5 (2–7)	3.5 (1–7)	0.437
Timed Up-and-Go (s)	24.3 (13.8–94.5)	30.8 (13.8–45.5)	24.3 (18.0–94.5)	1.000
Emotional and cognitive characteristics				
SF-8 (0–40 score)	31 (14–39)	34 (14–39)	29.5 (20–39)	0.616
GDS—Short Form (0–15 score)	5 (3–12)	4.5 (4–8)	8 (3–12)	0.051
MMSE (0–35 score)	28.5 (19–34)	30.5 (20–33)	26.5 (19–34)	0.637

Note: The bold font value means significance of $p < 0.05$.
Abbreviations: Ab-Charlson, abbreviated Charlson comorbidity index; ASM, appendicular skeletal muscle mass; BMI, body mass index; GDS—Short Form, Geriatric Depression Scale—Short Form; MMSE, Mini-Mental State Examination; MNA, mini-malnutrition assessment screening; SF-8, eight-item Short-Form Health Survey; SPPB, Short Physical Performance Battery.
[a]*U* Mann–Whitney test.
[b]Chi-squared test.

physical–cognitive activities were reestablished (Resolución de 29 de mayo de, 2020).

In September 2020, the epidemiological evolution in the nursing home led to a second strict lockdown in this nursing home due to its incidence rate. Participants were confined to their rooms until December 2020, when mobility around the nursing home was restored. After this relaxation of the isolation measures, a follow-up assessment (T2) was carried out concurring with a 12-month time frame from the first assessment

TABLE 2 Analysis of functional and emotional variables assessments at pre-lockdown (T1), 12-month follow-up (T2), and 15-month follow-up (T3).

Variables	T1 Median (range) (*n* = 18)	T2 Median (range) (*n* = 12)	T3 Median (range) (*n* = 11)	χ^2_F	df	*p*-value[a]	*Z*	*p*-value[b]
Functional and physical characteristics								
Handgrip strength (kg)	19.5 (7.8–28.8)	18.1 (13.2–25.1)	16.1 (12–21.3)	1.636	2	0.441		NS
Chair stand test (s)	20.6 (15.8–34.1)	19.6 (13.5–25.8)	18.5 (15.5–42.8)	1.333	2	0.513		NS
Biceps brachii strength (kg)	10.6 (6.3–17.6)	6.9 (3.6–10.6)	4.7 (3.3–8.2)	16.55	2	<0.001	−2.982 −1.778 −2.934	0.001 T1–T2 0.025 T2–T3 0.001 T1–T3
Quadriceps strength (kg)	13.6 (6.8–27.7)	13.1 (3.5–20.9)	13 (6.2–17.0)	0.727	2	0.695		NS
ASM (kg)	15.0 (11.3–19.8)	15.3 (11.4–18.8)	14.9 (11.0–17.9)	5.636	2	0.060		NS
ASM Index (kg/m^2)	6.4 (5.0–8.5)	6.6 (5.2–8.4)	6.3 (5.0–8.0)	5.636	2	0.060		NS
Gait speed (m/s)	0.4 (0.1–0.9)	0.4 (0.1–0.7)	0.3 (0.1–0.6)	2.364	2	0.307		NS
SPPB (0–12 score)	4 (1–7)	4.5 (1–10)	3 (1–6)	4.5	1	0.034	−2.490 −2.484 −0.277	0.004 T1–T2 0.004 T2–T3 0.260 T1–T3
Balance (0–4 score)	2 (0–4)	2 (0–4)	1 (0–3)	12.563	2	0.002	−2.598 −2.588 −0.632	0.003 T1–T2 0.003 T2–T3 0.175 T1–T3
Side-by-side stand (s)	10 (0–10)	10 (4.5–10)	10 (7.6–10)	1.80	1	0.180		NS
Semi-tandem stand (s)	10 (0–10)	10 (0–10)	2 (0–10)	0.667	1	0.414		NS
Tandem stand (s)	0.5 (0–10)	2.1 (0–10)	0.0 (0–3.3)	0.000	1	1.000		NS
4-m walk (0–4 score)	1 (1–2)	1 (1–3)	1 (1–2)	1.80	1	0.180		NS
Walk (s)	10.1 (4.6–48.1)	10.5 (5.8–61.0)	12.9 (6.5–72.2)	2.634	2	0.307		NS
Chair stand test (0–4 score)	1 (0–2)	1 (0–3)	1 (0–2)	1.80	1	0.180		NS
Timed Up-and-Go (s)	24.3 (13.8–94.5)	33.2 (16.81–127.42)	28.2 (15.5–176.0)	3.455	2	0.178		NS
Emotional and cognitive characteristics								
MMSE (0–35 score)	28.5 (19–34)	27.5 (16–35)	25 (16–35)	8.581	2	0.014	−2.439 −1.633 −2.313	0.005 T1–T2 0.034 T2–T3 0.007 T1–T3
GDS—Short Form (0–15 score)	5 (3–12)	8.5 (5–13)	8 (5–12)	6.867	2	0.032	−2.418	0.005 T1–T2
SF-8 (0–40 score)	31 (14–39)	25 (13–35)	24.5 (18–39)	3.368	2	0.186		NS

Abbreviations: ASM, appendicular skeletal muscle mass; GDS—Short Form, Geriatric Depression Scale—Short Form; MMSE, Mini-Mental State Examination; NS, nonsignificant; SF-8, eight-item Short-Form Health Survey; SPPB, Short Physical Performance Battery.
[a]Friedman test.
[b]Post hoc Wilcoxon test.

of the participants. Although the vaccination schedule began in January 2021 and all study participants were vaccinated, an outbreak occurred within the nursing home that led to a new isolation lockdown until March 2021. It should be noted that none of the participants contracted the SARS-CoV-2 virus. Once this isolation period ended (March 2021), the second follow-up was conducted (T3).

2.7 | Statistical analyses

Statistical analyses were carried out in SPSS 26 (IBM Corporation, Armonk, NY, USA) and included, for descriptive purposes, the median and minimum–maximum values for quantitative variables, whereas the number of cases and percentages were estimated for categorical variables. The assumption of normality of the dependent variable was not met, and since the study had a small sample size, nonparametric inferential statistics were applied. To compare baseline characteristics according to sex, Mann–Whitney *U* tests were conducted for quantitative variables, and for qualitative variables, the nonparametric chi-squared test was carried out. For inferential analyses, to compare the variables at the three time points of functional and emotional variables, Friedman's ANOVA and post hoc Wilcoxon's test were used, adjusting the significance for the total number of comparisons.

TABLE 3 Sarcopenia classification following the four steps of the EWGSOP2 algorithm: individual scores for the 12 participants that were assessed at follow-up.

		SARC-F (0–10 score)			Chair stand test (s)			ASM			Gait speed (m/s)			Classification		
Participant	Sex	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	W	4	4	4	15.86	18.87	18.36	14.29	15.50	14.91	0.36	0.53	0.54	SS	PS	SS
2	M	6	6	7	34.14	[a]	[a]	19.03	18.84	17.91	0.26	0.09	0.07	SS	SS	SS
3	M	4	4	D	20.64	25.83	D	[b]	[b]	D	0.43	0.35	D	PS	PS	D
4	M	8	8	5	[a]	[a]	[a]	16.03	16.91	15.49	0.31	0.42	0.53	SS	SS	SS
5	W	9	9	7	[a]	[a]	[a]	16.92	15.13	15.58	0.21	0.33	0.28	PS	PS	PS
6	W	7	7	7	22.63	[a]	[a]	16.16	15.78	15.80	0.51	0.23	0.28	PS	PS	PS
7	W	6	6	5	26.45	19.63	18.72	15.24	12.86	12.34	0.27	0.35	0.28	PS	SS	SS
8	M	4	4	6	15.8	13.45	27.72	15.05	15.41	14.81	0.87	0.67	0.31	CS	PS	SS
9	W	4	4	7	18.3	23.19	42.83	12.02	11.44	11.01	0.49	0.52	0.40	SS	SS	SS
10	W	7	7	7	[a]	[a]	[a]	14.72	13.98	12.88	0.08	0.07	0.06	SS	SS	SS
11	W	4	4	5	15.76	19.03	16.60	16.67	15.32	14.60	0.42	0.44	0.36	PS	PS	SS
12	W	6	6	6	16.73	20.2	15.48	11.33	14.09	15.30	0.56	0.69	0.61	SS	SS	PS

Note: Participant number 3 had a pacemaker so bioimpedance analysis was contraindicated.
Abbreviations: ASM, appendicular skeletal muscle mass; CS, confirmed sarcopenia; D, death; M, man; PS, probable sarcopenia; SS, severe sarcopenia; T1, pre-lockdown; T2, 12-month follow-up; T3, 15-month follow-up; W, woman.
[a]Inability to perform the test.
[b]Inability to perform bioimpedance analysis, precludes classifying this participant beyond confirmed sarcopenia.

3 | RESULTS

A total of 18 institutionalized older adults with sarcopenia were analyzed, with a median age of 86.5 years, 66.7% being women. Enrollment and follow-up data are depicted in Figure 1.

The baseline characteristics of the sample (Table 1) showed a low number of hospitalizations, low comorbidity, absence of malnutrition, and an acceptable quality of life. However, participants were overweight (>25 kg/m^2), had moderate dependence for ADL, polypharmacy, and two thirds were frail. The baseline characteristics between sexes showed significant differences related to muscle strength and quantity, but not in physical performance variables. In relation to emotional and cognitive characteristics, women showed a higher level of depressive symptoms.

3.1 | Functional and physical changes between pre-lockdown, 12-month follow-up, and 15-month follow-up

Sarcopenia screening with the SARC-F did not significantly change at follow-up measurements, $\chi^2(2) = 0.283$, $p = 0.86$. The muscle strength variables showed a slightly different behavior between the upper and lower limbs. Regarding upper limbs, there was a significant decrease in biceps brachii strength ($\chi^2(2) = 16.55$, $p < 0.001$) (Table 2) and a decreasing trend of handgrip strength median through the follow-up measurements. In relation to lower limbs, neither the chair stand test nor the quadriceps femoris strength significantly changed, although there was a decreasing trend in the medians of both over time. Moreover, there was an increase in the number of people unable to perform the chair stand test (Table 3), from three people at T1 to five at T2 and T3.

Regarding muscle mass variables, no significant changes were observed for any of them at T2 or T3, nor was there a notable change in the values of the medians.

In relation to physical performance, although there was no significant change in gait speed, an analysis conducted on the time spent when performing the Timed Up-and-Go test, and the Short Physical Performance Battery walking subtest showed the walking time increased, as can be seen in the median and the minimum and maximum intervals. This was more evident for the Short Physical Performance Battery walking subtest, and for the Timed Up-and-Go test, the decline was more evident between T1 and T2 than T1 and T3. A more detailed analysis of the individual changes in these tests is depicted in Table 4.

Moreover, the Short Physical Performance Battery showed significant differences, with an increase in the medians between T1 and T2, based on the increase in the balance component. However, there was a decrease between T2 and T3, which is also observed in the balance test for the tandem position. In this regard, in T3, balance in the tandem position is compromised. Moreover, an increase in people unable to perform semi-tandem and tandem was observed at T3 (Table 4).

An additional analysis compared the number of participants' falls during the year prior to the lockdown (March 2019–March 2020, retrieved from the institution's database) with falls during the year of lockdown (March 2020–March 2021), which showed a decrease in the median number of falls: 0.5 (0–16) versus 0 (0–8) ($p = 0.033$), respectively.

TABLE 4 Time spent in balance and gait tests of the SPPB, and in the TUG: individual scores for the 12 participants that were assessed at follow-up.

Participant	Sex	Side-by-side stand (s)			Semi-tandem (s)			Tandem (s)			4-m walk (s)			Timed Up-and-Go (s)		
		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	W	10	10	10	10	10	10	1.73	10	3.29	11.14	7.48	7.37	25.11	22.44	16.73
2	M	0	4.05	7.58	0	0	0	0	0	0	15.67	46.40	55.47	41.61	124.00	132.00
3	M	10	10	D	10	10	D	4.10	4.20	D	9.35	11.29	D	21.48	30.29	D
4	M	10	10	10	10	10	10	0	2.63	1.38	13.10	9.45	7.60	45.48	36.14	25.58
5	W	0	10	10	0	10	1.30	0	1.40	0	18.66	12.14	14.45	45.59	48.45	63.00
6	W	4.51	10	10	0	10	7.99	0	0	0	7.88	17.18	14.06	23.49	80.87	39.15
7	W	10	10	10	1.55	10	2.01	0	4.05	0	14.96	11.58	14.51	27.42	42.49	41.57
8	M	10	10	10	10	10	0	10	10	0	4.61	5.94	12.86	13.79	18.04	22.01
9	W	10	10	10	6.00	10	10	0	1.59	0	8.19	7.64	9.95	18.73	19.82	23.73
10	W	0	10	10	0	10	0	0	0	0	48.11	60.19	72.24	94.51	127.42	176.00
11	W	10	10	9.06	6.15	10	0	0	0	0	9.48	9.14	11.04	18.04	25.02	28.22
12	W	10	10	10	10	10	10	1.04	7.86	0	7.18	5.76	6.52	20.50	16.81	15.53

Abbreviations: D, death; M, man; SPPB, Short Physical Performance Battery; T1, time 1 or pre-lockdown; T2, time 2 or post-lockdown 12 months; T3, time 3 or post-lockdown 15 months; TUG, Timed Up-and-Go; W, woman.

3.2 | Emotional and cognitive changes between pre-lockdown, 12-month follow-up, and 15-month follow-up

The participants had significant cognitive deterioration ($\chi^2(2) = 8.581$, $p < 0.014$). Moreover, a significant increase in the score of the Geriatric Depression Scale—Short Form was observed ($\chi^2(2) = 6.867$, $p < 0.032$), with differences between T1 and T2. Moreover, there was a decreasing trend in the medians of the SF-8 quality of life questionnaire.

4 | DISCUSSION

This study showed that bicep strength was significantly reduced during lockdown, and other upper and lower limb strength variables all showed a decreasing trend, although no changes were found regarding muscle mass. Regarding physical performance, the Short Physical Performance Battery showed significant changes through the follow-up measurements, more specifically in the balance subtest. Moreover, cognitive and emotional characteristics were significantly affected, and quality of life showed a decreasing trend.

In regard to sarcopenia variables, muscle strength is a determinant of sarcopenia (Cruz-Jentoft et al., 2019) and is associated with morbidity in older adults, thus our results for strength variables could be of interest when studying sarcopenia. Independent mobility is probably one of the last daily tasks to be lost with aging (Sousa et al., 2015), and although institutionalized older adults were confined to their bedrooms during lockdown, walking, though reduced, was still an activity they could do. Thus, lower limb muscles may have been more dynamic. However, previously practiced activities, such as strength and balance exercises, were not implemented during lockdown. This may explain why biceps brachii strength did show a significant decrease and why generally both upper and lower limb muscles showed a trend of impairment. This detraining, especially in upper limbs, may have led to muscle disuse during lockdown, which has shown to be accompanied by a decline in strength (Wall & van Loon, 2013) and may have substantially contributed to the decline in biceps brachii strength. Moreover, it has previously been stated that older adults with a moderate-to-low physical activity status can show a decline in muscle strength, and this decline can impact their ability to rise from a chair or use the toilet with or without assistance (Wall & van Loon, 2013). In this study, there was a decrease in the number of participants able to perform the chair stand test at follow-up, which again suggests that lower limb strength was somehow affected.

Higher levels of upper and lower limb muscle strength have been previously associated with a lower risk of mortality (García-Hermoso et al., 2018). Therefore, in nursing homes where the population is more vulnerable and which may still have isolation measures, it seems the assessment of muscle strength could be considered to be valuable. If sarcopenia and functional decline are detected early, they can be treated early and their consequences can be prevented (Cebrià i

Iranzo et al., 2020). In addition, in relation to the results of the study, clinicians could consider that physical exercise may always have to be balanced between upper and lower limbs. If isolation measures do not allow supervised treatment in person, telerehabilitation programs could offer a solution for institutionalized older adults with sarcopenia.

Another of the sarcopenia variables, muscle mass, had no significant changes. Other studies related to COVID-19 pandemic restrictions have also reported no change in muscle mass (Hasegawa et al., 2021). Previous studies that also focused on participants with sarcopenia but had implemented resistance training (Cebrià i Iranzo et al., 2018) did not show changes in muscle mass but did for strength. Further, the latest sarcopenia guidelines indicate that strength is better than mass in predicting adverse outcomes (Cruz-Jentoft et al., 2019).

Due to aging, there are decrements in muscle size, which occur at a 0.5%–0.8% annual rate for people over 50 years of age, or higher after 60, due to loss of fiber number (Deschenes, 2004). Considering our sample median age was 86.5 years, muscle mass medians suggest that the near-to-cutoff values may be more related to aging than to lockdown mobility restrictions. However, loss of muscle mass among the aged directly results in diminished muscle function (Morley et al., 2020), which may explain our results regarding muscle strength and performance. Thus, participants had an initial low muscle mass and lockdown conditions reduced their strength and physical capability.

Following the sarcopenia algorithm, the physical performance assessments showed a deterioration between T1 and T3 for gait speed, Timed Up-and-Go test, and Short Physical Performance Battery, and the latter had statistical changes throughout the follow-up. All of them were already experiencing deterioration at baseline, which reinforces the idea that aging involves functional loss (Garcia Meneguci et al., 2021). Moreover, the scores got worse at follow-up, probably due to mobility restrictions, thus not performing physical activity regularly relates to functional and physical decline (Kirwan et al., 2020). This is in line with a previous study that also detected a decrease in physical performance during the COVID-19 lockdown in nursing homes (De Souza Oliveira et al., 2023). Poor physical performance and institutionalization are associated with disability (Serrano-Urrea et al., 2017); thus, our participants may have increased their disability risk during lockdown. Moreover, when analyzing the Short Physical Performance Battery subtests, the balance subtest showed a significant decrease. Agility skills and balance have been shown to be significant in relation to disability, especially in instrumental ADL. Therefore, the physical function of our participants during the 15-month period declined and probably could have placed them at a higher risk of morbidity, which, in the pandemic, was not a minor problem.

Sarcopenia is associated with functional disability, a higher rate of falls, fractures, and incidence of hospitalizations (Beaudart et al., 2017). Moreover, in Spain, a significant proportion of COVID-19-associated deaths have been in nursing homes (Fallon et al., 2020). In spite of this, participants had low rates of hospitalizations, and the number of falls during the year of restrictions compared with the prior was reduced. The decrease in physical activity, walking, and movement due to isolation measures could explain this. In terms of sarcopenia screening, the decrease in the number of falls, although it led to a decrease in the SARC-F score (participants 4, 5, and 7), did not prevent them from becoming probable sarcopenic (score >4).

The results of the present study also showed there was a significant decrease in the cognitive and emotional sphere. Some risk factors previously described for cognitive impairment are physical activity reduction and an increase in sedentary behavior, both of which were aspects of lockdown and are also associated with sarcopenia (Ammar et al., 2020). Moreover, there was a higher suspicion of depression at follow-up, and this is related to a further decline in cognition (Santos et al., 2017). Depression and loneliness have also been related to falls, fear of falling, and disability (Martínez-Arnau et al., 2021). Previous studies have concluded that all older adult groups experienced depression and anxiety during the pandemic (Meng et al., 2020), and we have reported a significant cognitive change. Quality of life also showed a decrease, which can be explained by restrictive measures, loneliness, fear, and decrease in physical and mental stimulation, as has been shown by another study related to lockdown (Savci et al., 2021). Other studies have also shown a worsening in rates of depression (Meng et al., 2020) and cognitive functioning, and a decline in the well-being of nursing home residents as a result of lockdown (Levere et al., 2021).

4.1 | Limitations and strengths

The main limitation of the study was not having a control group, which did not allow us to assess whether those without sarcopenia might have deteriorated in the same manner and eventually become sarcopenic. Other limitations were the small sample size and the fact that the study was a single-center one. We did not have access to other nursing homes because external researchers were not allowed in institutions where populations such as older adults, who are especially vulnerable to COVID-19 with high mortality rate, lived. However, our objective was not statistical generalization but rather to provide transferability to similar contexts and guidance for health professionals regarding the physical and/or emotional consequences of isolation measures.

As strengths, our study shows a 15-month follow-up at a time when researchers were not allowed to access nursing homes and only workers could do so. In addition, participants were from the same center, thus making it possible to control nutritional habits and lifestyle conditions. Finally, our results, although interpreted with caution, suggest that nursing home clinicians could focus on assessing muscle strength, balancing upper and lower limb exercises, and focus on their emotional areas when isolation measures are applied, such as during the COVID-19 pandemic. Future research could further consider the importance of studying the impact of disuse in older adults with sarcopenia, and how muscle strength may contribute to maintaining independence and preventing further deterioration.

5 | CONCLUSIONS

Lockdown for institutionalized older adults with sarcopenia is associated with a loss of functional capacity and emotional deterioration, which clinicians should address in isolation measures due to COVID-19 or other infectious diseases. Particularly, biceps brachii strength and Short Physical Performance Battery performance are the measurements that show the greatest deterioration in physical condition, although our results should be considered with caution due to our small sample size.

5.1 | Clinical implications

In nursing homes, there are high rates of sarcopenic older adults due to sedentary behavior and a higher prevalence of comorbidities. Our results seem to highlight that nursing home clinicians could focus on assessing muscle strength and balancing upper and lower limb exercises if isolation periods are required. Addressing the emotional areas of institutionalized older adults with sarcopenia is also of paramount importance. Therefore, both physical and emotional spheres should be taken into account in isolation situations that may occur in the healthcare of vulnerable populations.

AUTHOR CONTRIBUTIONS

Anna Arnal-Gómez: Conceptualization; methodology; formal analysis; writing – original draft; writing – review and editing; investigation. **Natalia Cezón-Serrano:** Conceptualization; methodology; investigation; formal analysis; data curation; writing – original draft; writing – review and editing. **Laura Arjona-Tinaut:** Conceptualization; methodology; investigation; writing – original draft; writing – review and editing. **María Àngels Cebria i Iranzo:** Conceptualization; methodology; investigation; formal analysis; data curation; writing – original draft; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data is available under reasonable request.

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