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Understanding deinstitutionalization policies for older adults through sarcopenia and the place of aging in Spain

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To support deinstitutionalization policies in Spain, it's useful to understand sarcopenia determinants. This study analyzed 267 community-dwelling and institutionalized older adults, measured sarcopenia using the European Working Group of Sarcopenia in Older People 2 (EWGSOP2) algorithm and looked for the role of place of aging among a set of social, economic, psychological and environmental variables. Findings reveal that the place of aging might have a significant relationship with sarcopenia in Spanish older adults and that a large proportion of older adults with sarcopenia could end up living in institutions. These results are in accordance with some actions lines of the deinstitutionalization Spanish strategy and point out that it would be necessary to prevent sarcopenia, mainly in the oldest, in those with low cognitive status and quality of life in order to promote deinstitutionalization and retain older adults in their community as much as possible.

Keywords Sarcopenia, Determinants, Place of aging, Deinstitutionalization, Older adults

Any health policy should consider all health determinants, including social and environmental ones, which are less studied than biological, clinical and functional ones[1]. Environmental determinants and the places where people age and develop their lives are relevant factors that influence the health of older adults. The 2030 Agenda for Sustainable Development Goals of the United Nations, the European Union (EU) social rights plan, and its active aging regulations, guide actions to improve the living conditions of health of older adults nowadays. For European countries, the European Strategy for the care of older adults recommends deinstitutionalization[2]. In accordance with this, the Government of Spain regulated its "Recovery, Transformation and Resilience Plan" in 2021, including the commitment to develop a new model of care for older adults. At present, this objective applies through the "State strategy for a new model of care in the community" which focuses on promoting autonomy and reduce the risk of institutionalization[3]. Deinstitutionalization implies an important cultural care change from a care-oriented model to a human rights care-model. The Spanish strategy aims to keep older adults healthy, aging, and cared for in their community (wherever they live), respecting their rights and maintaining the possibility of fulfilling their life itineraries.

The Spanish strategy's operational plan incorporates a series of axes and lines of action (1 and 4) focused on promoting a preventive and community-based approach to care, and diversification of services. Care for older adults in Spain continues to fall mainly on families despite the development of the long-term care (LTC) system, which, of itself, remains insufficient due to the growing demand for services[4–6].

Sarcopenia is a symptom of frailty and deteriorating health, and could lead to institutionalization-related risks. It is recognized as a public health problem due to its relevant consequences and high prevalence[7]. The European Working Group on Sarcopenia in Older People (EWGSOP2) criteria found that its prevalence is between a range of 4–21%[8–12] and, using the Asian Working Group for Sarcopenia 2019 (AWGS2019) around

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10–27% in China[13]. A similar trend has also been found in Spain[14–16]. To reduce its prevalence and other effects (such as institutionalization) it could be valuable to know its determinants.

International studies indicate that the determinants of sarcopenia are broad and vary according to the indicators used[17]. The present study aims to emerge relevant social, economic, psychological and environmental determinants of sarcopenia, focusing on the role of aging in place.

Previous literature has focused on the aging in place concept regarding different topics[18]. For the proposal of this study, the selected topic is the place where people live and age (community or institution). Among them, little is known about the role place of aging plays, with most studies providing information separately on older adults living in the community or in nursing homes. However, issues related to neighborhood, environment, and residential density in relation to sarcopenia are studied, mainly in Asiatic countries. High residential density was found to promote physical activity and improved health outcomes, with more evidence in rural areas[19]. On the effect of neighborhood from a longitudinal study Okuyama et al. showed that the neighborhood environment in rural Japan had limited effects on the change of skeletal muscle index and grip strength[20]. Even neighborhood walkability does not protect older adults from sarcopenia in Taiwan[21]. Other types of environmental characteristics of urban areas in Korea were associated with an increased risk of sarcopenia in older adults, such as lack of access to public transportation, poor access to recreational facilities, many hillside hazards and lack of traffic safety[22]. Moreover, in Korea too, Seok et al. found that high household income, high per capita area of sports facility in the neighborhood, and high life satisfaction were relevant factors in reducing sarcopenia[23].

The latest meta-analysis study on the determinants of sarcopenia highlights the importance of environmental factors of the neighborhood (characteristics and place where older adults live), food, and pollutants[24].

In Spain, knowledge about the place of aging and other socioeconomic determinants of sarcopenia in older adults is still scarce. We hypothesize that the place where Spanish older adults live and age, along with some socioeconomic determinants, will influence the prevalence of sarcopenia. In our opinion, this information about the determinants of sarcopenia could be valuable for the purposes of Spain's current deinstitutionalization strategy (axes and action lines 1 and 4), and the adaptation of long-term care models towards a community-based vision[3].

Methods

Design

A multicenter cross-sectional study was conducted between January 2019 and February 2020 among community-dwelling and institutionalized older adults in the province of Valencia (Spain).

This study was approved by the Ethics Committee for Human Research of University of Valencia (H1542733812827). All the research was performed in accordance with the Declaration of Helsinki, and written consent was obtained from all participants.

Participants

The study included 267 older adults with recruitment done by convenience sampling. Institutionalized older adults were recruited in nursing homes, while community-dwelling older adults were recruited through cultural associations and social centers for older adults. Community-dwelling older adults were not receiving long-term care. In both settings, older adults over 64 years of age were included. Participation rates were very similar in both settings, 49% were institutionalized older adults.

Exclusion criteria were: Edema interfering with the bioimpedance analysis (BIA); Mini-Mental State Examination (MMSE) <18 points, excluding older adults with severe mental impairment[25] acute disease, hospital admission or unstable chronic disease in the last month; and inability to perform physical tests for the diagnosis of sarcopenia.

Output. Sarcopenia definition and variables' measurements

According to the EWGSOP2 algorithm, detection of sarcopenia was conducted considering the SARC-F questionnaire, strength and muscle mass, and physical performance measurements[26].

SARC-F is a 5-items questionnaire regarding strength, walking assistance, ability to rise from a chair, climb stairs, and falls. It identifies cases of sarcopenia when the score is ≥ 4 points of a total score of 12[27].

Muscle strength was measured by chair stand test in which participants have to stand up five times as quickly as possible from a chair without stopping, and time (s) was registered. Strength cut-off point was >15 s[26].

Appendicular Skeletal Muscle Mass (ASM) was determined with BIA through Bodystat® 1500MDD (Bodystat Ltd., Douglas, UK). The Sergi's BIA equation was applied to calculate ASM[28]. ASM (kg) $= -3.964 + (0.227*RI) + (0.095*weight) + (1.384*gender) + (0.064*Xc)$, where resistive index (RI), resistance (ohms), height (cm), weight (kg), gender was 1 in men and 0 in women, and reactance (Xc, ohms). ASM cut-off points for low mass were <20 kg for men and <15 kg for women[26].

Physical performance was measured by the Short Physical Performance Battery (SPPB) examining ability to stand with the feet in different positions, time to walk four meters and rising from a chair five times, score ≤ 8 was the cut-off point[29].

Applying the EWGSOP2 criteria, sarcopenia was classified as: Probable, with SARC-F scored ≥ 4 points and low muscle strength (chair stand test >15 s); confirmed, when low quantity muscle was also detected (ASM <20 kg for men and <15 kg for women); and severe, when low physical performance (SPPB ≤ 8 points score) was also added. However, for the purpose of this study, two main groups were identified: Sarcopenic (probable, confirmed, severe) and non-sarcopenic participants, for statistical sample reasons[14].

Variables

In this study we assessed a complete set of health-related determinants of sarcopenia, such as anthropometric, social, economic, psychological, and nutritional status.

Anthropometric determinants

1) Age and sex; 2) height (cm), measured with a stadiometer SECA 213 (Seca Ltd. Hamburg, Germany); 3) weight (kg); 4) body mass index (BMI) (kg/m^2).

Social determinants

1) Marital status: Married, non-married, widow; 2) Educational level: Not completed secondary/high school, completed secondary/high school, completed tertiary education.

Environmental determinants

1) Place of aging: Community-dwelling, institutionalized; 2) Cohabitation: Alone/caregiver, family, nursing home.

Economic determinants

1) Perceived economic situation: Relieved, it meets basic needs (BN), finds it hard to meet BN; 2) Occupation: High-skilled white-collar (HSWC), low-skilled white-collar (LSWC) or blue-collar (BC), and housewives, based on International Standard Classification of Occupations (ISCO-88) coding system[30].

Psychological determinants

1) Cognitive status, measured by Mini Mental State Examination (MMSE) (0–35 score)[25] 2) Health-related quality of life, assessed with the eight-item short-form health survey (SF-8, 0–40 score), a higher score means better quality of life[31] 3) Sleeping problems: Yes/no; 4) Depression, assessed by the Center for Epidemiology Studies Depression Scale Short Form (CESD-7, 0–21 score)[32] 5) Depressive symptoms: Based on the CESD-7 cut-off point for depressive symptoms, where ≤9 points indicates depression mood and >9 absence of depression[32] 6) Fear of falling: Yes/no.

Nutritional status

1) Nutritional status, assessed by Mini Nutritional Assessment-Short Form (MNA®-SF, 0–14 score), which classifies normal nutritional state (12–14 points), risk of malnutrition (8–11 points) and malnutrition (< 7 points)[33].

Marital status, educational level, cohabitation, place of aging, perceived economic situation, occupation, sleeping problems, depressive symptoms, and fear of falling variables were recorded using an ad hoc questionnaire.

Statistical analyses

All statistical analyses were performed with R and SPSS Statistics v28 for Windows (SPSS Inc. Chicago, Il. USA).

For descriptive purposes, mean and standard deviation for quantitative variables were calculated, whereas percentages were estimated for categorical variables. Differences among groups were estimated by the Student's or Welch's t-test for the continuous variables, and Chi-squared test for categorical ones. After bivariate analysis, variables with a significant association with sarcopenia were selected and a multiple logistic regression model was proposed using the glm function of the R base package.

We used the step function of the R package Stats with the backward strategy to refine the model excluding irrelevant predictors and obtain the final model using the Akaike Information Criterion (AIC) value obtained for each model. The glm function of the base R package is used to study the fixed effects of the regression model. We also study the random of the variable (place of aging) effects through the glmer function of the R package lme4 and it was estimated a model with mix effects. The parameter estimates (beta coefficients) were obtained with the corresponding confidence intervals. We interpreted the exponential of the parameter estimate as the odds ratio associated with each predictor. All statistical tests employed were considered statistically significant at $p < 0.05$. Once the best model was estimated, its predictive capacity was validated using a simple validation method. The technique used consisted of randomly dividing the data into two groups, train and test (70%–30%), fitting the model with the first group and estimating the accuracy of the predictions with the second group.

Results

Sample characteristics

The sample mean age was 76.9 years old (range 65–99), women were significantly older than men ($p < 0.013$). Most participants were women (73.8%) and community-dwelling (50.6%) (Table 1).

According to the cut-off points of the EWGSOP2 algorithm, SARC-F values were lower than four points for both men and women. Chair stand tests scored below cut-off point in both sexes, being just under cut-off for women. In addition, both ASM and SPPB were just under cut-off for women, and over cut-off for men.

More than half of the older adults had not completed high school (55.4%). There was a higher number of women who were widows while men were mostly married. Regarding occupation, equal proportions of male and female were high-skilled white-collar workers, while more women were blue-collar, and only women were housewives. Our sample was generally able to meet their basic needs or had a relieved economic situation, as opposed to 6% who were unable to meet basic needs. And more women were in worse economic conditions than men.

Variables	Total (n = 267)	Women (n = 197)	Men (n = 70)	*p*-value
Anthropometrics				
Age (years)	76.9 ± 8.9	77.7 ± 9.2	74.8 ± 7.9	0.013
Height (cm)	156.3 ± 8.7	153.0 ± 6.3	165.8 ± 7.4	< 0.001
Weight (kg)	68.8 ± 12.8	65.7 ± 11.7	77.5 ± 11.7	< 0.001
BMI (kg/m^2)	28.1 ± 4.4	28.1 ± 4.7	28.2 ± 3.8	0.86
EWGSOP2 algorithm				
SARC-F (0–10 score)	2.4 ± 2.6	2.6 ± 2.6	1.7 ± 2.5	0.016
Chair stand test (s)	14.5 ± 5.9	14.9 ± 5.9	13.7 ± 5.9	0.19
ASM (kg)	16.4 ± 3.9	14.7 ± 2.6	21.1 ± 3.2	< 0.001
SPPB (0–12 score)	7.9 ± 3.6	7.5 ± 3.7	9.0 ± 3.2	0.001
Social characteristics				
Education level				
Not completed secondary/high school	148 (55.4)	117 (59.4)	31 (44.3)	< 0.001
Completed secondary/high school	57 (21.4)	35 (17.8)	22 (31.4)	
Completed tertiary education	62 (23.2)	45 (22.8)	17 (24.3)	
Marital status				
Non-married	55 (20.6)	41 (20.8)	14 (20)	< 0.001
Married	101 (37.8)	56 (28.4)	45 (64.3)	
Widowed	111 (41.6)	100 (50.8)	11 (15.7)	
Environmental characteristics				
Cohabitation				
Alone or caregiver	38 (14.2)	37 (18.8)	1 (1.4)	< 0.001
Family	97 (36.4)	58 (29.4)	39 (55.7)	
Nursing home	132 (49.4)	102 (51.8)	30 (42.9)	
Place of aging				
Community-dwelling	135 (50.6)	95 (48.2)	40 (57.1)	0.20
Institution	132 (48.4)	102 (51.8)	30 (42.9)	
Economic characteristics				
Occupation				
HSWC	71 (26.8)	52 (26.4)	19 (27.1)	< 0.001
LSWC	48 (18.1)	31 (15.7)	17 (24.3)	
BC	105 (39.6)	72 (36.5)	33 (47.1)	
Housewife	41 (15.5)	41 (20.8)	0 (0)	
Perceived economic situation				
Relieved	134 (50.2)	94 (47.7)	40 (57.1)	0.37
Meets BN	117 (43.8)	90 (45.7)	27 (38.6)	
Finds it hard to meet BN	16 (6)	13 (6.6)	3 (4.3)	
Psychological characteristics				
Cognitive status	29.1 ± 5.2	28.7 ± 5.2	30.2 ± 4.9	0.042
SF-8 (0–40 score)	32.1 ± 6.3	31.5 ± 6.1	33.9 ± 6.6	0.006
Sleeping problems (yes)	167 (62.5)	131 (66.5)	36 (51.4)	0.025
CESD-7 (0–21 score)	5.3 ± 5.5	5.8 ± 5.6	3.8 ± 5.0	0.007
Depressive symptoms (yes)	65 (24.4)	55 (28.1)	10 (14.3)	0.021
Fear of falling (yes)	109 (40.8)	91 (46.7)	18 (25.7)	0.003
Nutritional status				
Continued				

Variables	Total (n = 267)	Women (n = 197)	Men (n = 70)	*p*-value
MNA-SF (0–14 score)	12.3 ± 1.8	12.2 ± 1.7	12.4 ± 2.0	0.45
Risk of malnutrition				
Normal (12–14)	198 (77.3)	142 (75.9)	56 (80)	0.59
In risk (8–11)	57 (22.3)	44 (23.5)	13 (18.6)	
Malnutrition (0–7)	1 (0.4)	1 (0.5)	0 (0)	

Table 1. Characteristics of the participants according to gender: Mean ± standard deviation or number of cases (%). Abbreviations: BMI=body mass index; ASM=appendicular skeletal muscle mass; SPPB=short physical performance battery; HSWC=high-skilled white-collar; LSWC=low-skilled white-collar; BC=blue-collar; BN=basic needs; SF-8=the short-form-8 health-related quality of life; CESD-7=depression scale of the Center for Epidemiologic Studies; MNA-SF=mini-malnutrition assessment short-form.

On a psychological level, women had significantly lower cognitive level ($p = 0.042$), more sleeping problems ($p = 0.025$), more depressive symptoms ($p = 0.021$) and more fear of falling ($p = 0.003$). In general, nutritional status was normal in 75.9% of women and 80% of men.

Differences based on presence or absence of sarcopenia

When all the steps of the EWGSOP2 algorithm were applied, our sample was classified as sarcopenic (n = 86, 32.2%) or non-sarcopenic (n = 181; 67.8%) (Table 2). By gender, the prevalence of sarcopenia was 37.1% for women and 18.6% for men.

Regarding the presence or absence of sarcopenia, the results showed statistically significant differences in all variables (Table 2). Sarcopenic people were older than non-sarcopenic ones, 83.7 ± 8.0 and 73.8 ± 7.5 years old, respectively ($p < 0.001$). Among those with sarcopenia, 37.1% were women vs. 18.6% of men ($p < 0.004$).

In relation to social determinants, educational level showed that more than 80% of sarcopenic older adults had not completed secondary school, compared to 43% of non-sarcopenic people ($p < 0.001$). In terms of marital status, 64% of sarcopenic older adults were widowed, compared to 30.9% of non-sarcopenic ones ($p < 0.001$).

When looking at the studied environmental determinants (place of aging and cohabitation), 88.4% of sarcopenic older adults were living in institutions ($p < 0.001$).

At the economical level, occupation was significantly different between sarcopenic and non-sarcopenic groups ($p < 0.001$), with 35.6% of non-sarcopenic older adults having worked in high-skilled white-collar occupations and 50.6% of older adults with sarcopenia having worked in low-skilled white-collar occupations and 24.7% were housewives.

Additionally perceived economic situation showed that 62.4% of non-sarcopenic older adults had a relieved economic situation, while 66.3% of sarcopenic were caring for basic needs ($p < 0.001$).

At psychological level, cognitive status showed significant differences between sarcopenic and non-sarcopenic groups ($p < 0.001$), with scores of 25.6 ± 5.9 and 30.7 ± 3.8, respectively. Quality of life level (SF-8) showed also significant differences between sarcopenic and non-sarcopenic groups ($p < 0.001$), with scores of 33.2 ± 5.6 and 29.9 ± 7.2, respectively. Moreover, perceived sleeping problems were also significant ($p = 0.026$), with 72.1% of sarcopenic older adults perceiving them. Although the mean of the CESD-7 did not exceed the cut-off point for depressive symptoms, 17.1% of non-sarcopenic and 39.5% of sarcopenic individuals had depressive symptoms ($p < 0.001$). In addition, 60% of sarcopenic participants were afraid to fall compared to 32.4% of non-sarcopenic ones ($p < 0.001$).

At nutritional level, MNA-SF showed also significant differences between sarcopenic and non-sarcopenic groups ($p < 0.001$), with scores of 12.7 ± 1.7 and 11.5 ± 1.7, respectively. Furthermore, 42.4% of sarcopenic older adults were at risk of malnutrition compared to 81.6% of non-sarcopenic older adults with normal nutritional status ($p < 0.001$).

Predictive model

As previously stated, all variables were significant for the presence of sarcopenia.

However, after the application of the backward strategy, the variables selected to include in the model were age, place of aging, cognitive status, symptoms of depression, quality of life, fear of falling, and nutrition, since they gave the lowest AIC.

The predictive model that best explained the presence of sarcopenia is shown in Table 3. This model has a Pseudo-R^2 (Cragg-Uhler) = 0.56; Pseudo-R^2 (McFadden) = 0.41, and AIC = 200.74, and included as significative determinants: Age, place of aging (institution), cognitive status (low), and quality of life (low).

When the place of aging was introduced into the model as a random effect, the newly created mixed model did not improve the previous one (AIC = 207.91).

Finally, the predictive capacity of the best model, checked by the random division into two groups (70%–30%), has verified that the model could be generalized. The results of the model validation with the train data showed that the model is capable of correctly classifying 78.4% of the training observations, and with the test data, the model is able to correctly classify 87% of the observations.

Variables	Not sarcopenic (n=181)	Sarcopenic (n=86)	X^2 or t-test	*p*-value
Demographics				
Age (years)	73.8 ± 7.5	83.7 ± 8.0	−9.6	<0.001
Women (%)	124 (62.9)	73 (37.1)	8.1	0.004
Men (%)	57 (81.4)	13 (18.6)		
Social characteristics				
Education level				
Not completed secondary school	78 (43.1)	70 (81.4)	35.5	<0.001
Completed secondary school	47 (26.0)	10 (11.6)		
Completed tertiary education	56 (30.9)	6 (7.0)		
Marital status				
Non-married	39 (21.6)	16 (18.6)	29.5	<0.001
Married	86 (47.6)	15 (17.4)		
Widowed	56 (30.9)	55 (64.0)		
Environmental characteristics				
Cohabitation				
Alone or caregiver	34 (18.8)	4 (4.7)	77.2	<0.001
Family	91 (50.3)	6 (7.0)		
Institution	56 (30.9)	76 (88.4)		
Place of aging				
Community-dwelling	125 (69.1)	10 (11.6)	76.9	<0.001
Institution	56 (30.9)	76 (88.4)		
Economic characteristics				
Occupation				
HSWC	64 (35.6)	7 (8.2)	26.9	<0.001
LSWC	34 (18.9)	14 (16.5)		
BC	62 (34.4)	43 (50.6)		
Housewife	20 (11.1)	21 (24.7)		
Perceived economic situation				
Relieved	113 (62.4)	21 (24.4)	33.7	<0.001
Meets BN	60 (33.2)	57 (66.3)		
Finds it hard to meet BN	8 (4.4)	8 (9.3)		
Psychological characteristics				
Cognitive status	30.7 ± 3.8	25.6 ± 5.9	7.1	<0.001
SF-8 (0–40 score)	33.2 ± 5.6	29.9 ± 7.2	3.7	<0.001
Sleeping problems (yes)	105 (58)	62 (72.1)	4.9	0.026
CESD-7 (0–21 score)	4.5 ± 5.1	7.1 ± 5.8	−3.5	<0.001
Depressive symptoms (yes)	31 (17.1)	34 (39.5)	16.4	<0.001
Fear of falling (yes)	58 (32.4)	51 (60.0)	18.1	<0.001
Nutritional status				
MNA-SF (0–14 score)	12.7 ± 1.7	11.5 ± 1.7	5.4	<0.001
Risk of malnutrition				
Normal (12–14)	146 (81.6)	47 (55.3)	20.7	<0.001
In risk (8–11)	30 (16.8)	36 (42.4)		
Malnutrition (0–7)	3 (1.6)	2 (2.3)		

Table 2. Characteristics of the participants according to presence or absence of Sarcopenia: Mean ± standard deviation or number of cases (percentages). Chi-squared, Student-t or Welch-t test. Abbreviations: HSWC=high-skilled white-collar; LSWC=low-skilled white-collar; BC=blue-collar; BN=basic needs; SF-8=the short-form-8 health-related quality of life; CESD-7=depression scale of the Center for Epidemiologic Studies; MNA-SF=mini-malnutrition assessment short-form.

Discussion

This study showed the need for extensive information on the social determinants of health to be considered when regulating health and long-term care policies, as they also determine inequalities in health among the population[34]. Specifically, we have tried to provide this type of information to understand the deinstitutionalization policies of older adults considering sarcopenia and the place of aging in Spain.

Variables	Est	2.5%	97.5%	z val	*p-value*	exp(Est.)
(Intercept)	0.54	−5.36	6.44	0.18	0.86	1.72
Age	0.07	0.02	0.11	2.62	0.01	1.07
Cognitive status	−0.12	−0.19	−0.04	−3.07	0.00	0.89
Place of aging (Institution)	2.10	1.08	3.12	4.04	0.00	8.15
Depression symptoms	−0.89	−1.97	0.18	−1.63	0.10	0.41
Quality of life (SF-8)	−0.07	−0.15	−0.00	−2.00	0.05	0.93
Fear of falling	0.74	−0.03	1.51	1.88	0.06	2.09
Nutritional status (MNA-SF)	−0.20	−0.42	0.03	−1.72	0.09	0.82

Table 3. Binary logistic regression to explain sarcopenia. Abbreviations: exp(Est) = Odds ratio; SF-8 = the short-form-8 health-related quality of life; MNA-SF = mini-nutritional assessment short form. .

Our results for the Spanish older adult population are in line with previous international studies that point similar social factors for identifying sarcopenia in older adults[30,35–42], some put more emphasis on nutritional status or lower cognitive status[13,17,43–45] or issues related to the environment[23,24].

Our model highlights as predictive factors: The place of aging (nursing homes), age, low cognitive status, and low quality of life. Besides, it considers fear of falling, risk of malnutrition and depressive symptoms as a part of the model. Our results showed a positive association between nutritional status and depressive symptoms with sarcopenia. These point to bidirectionality between the variables, although they do not allow us to establish causality, so it would be necessary to perform longitudinal studies to verify it[46,47].

These results reveal that the place of aging might have a significant relationship with sarcopenia in Spanish older adults and that a large proportion of older adults with sarcopenia could end up living in institutions (nursing homes). However, we cannot establish the causality between them as longitudinal studies are needed.

Therefore, this study provides useful information to identify personal or contextual risk factors that could trigger institutionalization processes. This information could be used to articulate interventions that lead to changes in the life itinerary of older adults by applying preventive approaches. Early detection of risk factors, such as sarcopenia, is a key element in deinstitutionalization. These are the changes recommended by the EU strategy, expert groups, and the Spanish strategy currently operational[3,48–50].

Sarcopenia prevention programs will be successful if they are coordinated with other older adults' care programs and could help more of them to stay at home or in other institutions while preserve their autonomy to maintain the possibility of fulfilling their life itineraries. This will also be in accordance with the health priorities currently selected by a group of leading Spanish experts in health economics[51] and the last"Poverty and inequity"report in Spain[52], and are also in line with the new perspectives of health promotion policies that address and work locally as well as with social and environmental health and lifestyle behaviors of older adults[53]. Without coordination between the social agents and all the deinstitutionalization programs implemented at the local, regional and national levels, there will be no success[54,55] and the effects of an isolated program on environmental, economics or other programs will be low[19] and, thereby, inequalities among older adults will continue to exist[34]. In line with this, Basque Country Government (region of northern Spain) regulated an "Institutional pact on public and community care"[56]. This is a social pact that advocates a transversal, systemic, preventive and inclusive institutional care policy, and which is a benchmark reference in this field. Finally, the Spanish government, taking these initiatives and recommendations into account, has developed and implemented the current national strategy for a new model of care[3] which incorporates programs that could help prevent sarcopenia.

This study has some limitations. Firstly, the small sample size made it necessary to include as sarcopenic those with a diagnosis of probable sarcopenia. The fact of including a convenience sample also limits the generalizability of our results. Some studies used neighborhood characteristics to study the effect of environmental factors on sarcopenia. In our study, we only highlight the setting or place of aging, as we focus on the importance of deinstitutionalization policies and avoiding the future use of nursing homes. We also chose special type of economic indicators, among the heterogeneity of those used in the current health literature. The study did not take into account confounding variables such as comorbidities and physical activity, while the use of ad-hoc questionnaires with a markedly subjective character.

Nevertheless, as strengths, while some studies have started to relate sarcopenia and environmental factors, most of them did not use the EWGSOP2 algorithm in addition to other sarcopenia tests which have been all applied in the present study. Moreover, a long list of factors, usually not included in sarcopenia studies (such as occupation categories, perceived economic status, fear of falling) were used, adding more value to this study. Moreover, it follows the recommendations of the current lines of action proposed in the Spanish deinstitutionalization strategy (axes and lines of action 1 and 4).

In conclusion, when detecting the main determinants of sarcopenia risk in older adults in Spain, all the determinants considered in this study seem relevant. However, after searching for the best model to understand sarcopenia only the following were significative: Age, living in institutions, having a cognitive deterioration level, and low quality of life. However, other factors that regulators should also keep in mind are risks of falls, depression and malnutrition.

Therefore, the new model of care for older adults oriented towards deinstitutionalization implemented in Spain should act to prevent sarcopenia, mainly in the oldest, those with low cognitive status and quality of life, so that they can receive adequate care regardless of the place of aging.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Author contributions

M.A.T.C., N.C.S. and M.A.C.iI. conceived and designed the study; M.A.T.C., N.C.S., M.A.C.iI, T.S.M., A.A.G. and M.B.B. developed the methodology; N.C.S., M.A.C.iI, T.S.M., A.A.G. and M.B.B. participated in the data collection; M.A.T.C., N.C.S. and M.A.C.iI. participated in organization of the database; M.A.T.C., N.C.S. and M.A.C.iI participated in the interpretation of the results; M.A.T.C., N.C.S. and M.A.C.iI contributed to writing the manuscript. M.A.C.iI. supervised the research and administered the project. All authors read and approved the final manuscript.

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Declarations

Competing interests
The authors declare no competing interests.

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