

Article

Epidemiological Analysis of Cumulative Incidence and Mortality by COVID-19 in Nursing Homes in Catalonia: First and Second Waves

Jordi Esquirol Caussa^{1,2,3*}, Manuel García-San-Emeterio², Elisabeth Herrero Vila¹, Mariona Serra Peralta³, Miquel Colomer Giner³, Ignasi González Sánchez³, Salvador Moix Garolera³, Josep Farrés Quesada³ and Josep Sánchez Aldeguer^{2,3,4}

¹ Centre Mèdic Teknon (Barcelona)

² Servei Universitari de Recerca en Fisioteràpia. Escoles Universitàries Gimbernat (adscrites a la Universitat Autònoma de Barcelona, Sant Cugat del Vallès, Barcelona)

³ Secció de Metges de Residències. Filial Vallès Occidental. Acadèmia de Ciències Mèdiques i de la Salut de Catalunya i Balears. (Sabadell-Terrasa, Barcelona)

⁴ Facultat de Medicina. Universitat Autònoma de Barcelona. (Cerdanyola, Barcelona)

*Corresponding author: jordi.esquirol@eug.es

Abstract: Objectives: To analyze cumulative incidence and mortality by COVID-19 in the different types of nursing homes, in the first and second wave. Methods: Data source: Transparency portal of the Generalitat de Catalunya, official COVID-19 register of all Catalan nursing homes (from March to December 10, 2020). Variables: Affection of disease and mortality by COVID-19 in geriatric centers in Catalonia, stratified by size of center and type of management. Univariate, bivariate and multivariate linear regression analysis, IBMTMSPSS[®] v.20. Results: N = 1,057 residences (63,682 beds, average = 60.48). 52% have <50 beds, 42.8% between 50-150 beds, and 5% > 150 beds. COVID-19: Cumulative incidence: 21,370 (confirmed + suspicious); mortality: 5,010 (confirmed + suspicious). 233 residences did not register COVID-19 patients (22%) and 636 did not register COVID-19 deaths (60.2%). According to the type of supplier, the lowest incidence of COVID-19 was in non-accredited (36.2% without cases), then concerted / collaborators (19.3%) and own of the Generalitat de Catalunya (7.9 %, p = 0.000). The centers with the fewest deaths were the non-accredited (78% without deaths), followed by contracted / collaborators (56.8%) and those of the Generalitat de Catalunya (41.3%, p = 0.000). Depending on the size, no COVID-19 patients were registered: 168 centers <50 beds (30.5%); 64 of the 50-150 beds (14.2%); and 1 of the > 150 beds (1.9%) (p = 0.000). 395 of the <50 beds did not register deaths due to COVID-19 (71.8%), 232 of the 50-150 beds (51.3%), and 9 of the > 150 beds (17%) (p = 0.000). Discussion: Of the 1,057 centers analyzed, 22% did not register cases and in 60% there were no deaths from COVID-19. Residences without concert / collaboration with the Generalitat and with fewer beds showed a lower cumulative incidence and mortality due to COVID-19 during the first wave.

Keywords: COVID-19; nursing home; geriatric; incidence; mortality; epidemiology

1. Introduction

Elders institutionalized in geriatric and other long-term care centers are often vulnerable [1,2,3] due to their age and for the presence of concomitant diseases [4]. In this population, actions to prevent COVID-19 infection and control outbreaks must be a priority for all actors involved [1,2]. The first wave of the COVID-19 pandemic was truly like a "perfect storm": fragility, a possible lack of epidemiological training of the centers' staff (and in some cases, lack of medical staff, whether or not due to the pandemic) [2,5] and an initial shortage of material needed to control the pandemic were combined [4,5,6].

Evidence shows that, for example in Italy in the first outbreak of COVID-19, in municipalities with higher number of nursing homes mortality was higher than in

municipalities where there were no nursing homes [7] and in some cases mortality doubled its incidence. These data indicate that the possibility of living in a geriatric center could double the chance of dying from COVID-19 during the first outbreak (early 2020) [3]. It has also been reported that in Italy during the first wave of the pandemic, the centers were underfunded with protective equipment and, in addition, authorities decided to move the elderly with moderate symptoms to nursing homes to relieve the pressure on acute hospitals, increasing the risk and pressure on those centers, many of them understaffed for the correct control of this disease [7,8].

Despite the lack of uniformity of criteria in data collection, which complicates the epidemiological study, the impact of the disease among residents has been very significant in all Western countries studied, both in terms of incidence and mortality from this disease [9].

In the United States, Medicare and Medicaid systems use a nursing home comparison index using a quality rating system, providing each center with a rating of 1 to 5 stars. (<https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandCompliance/FSQRS>). Centers with 5 stars are considered to have a much higher quality than the average and those with 1 star have a much lower quality than the average. This 5-star overall rating for each nursing home is based on three sources of information: health inspections (based on the results of the previous 3 inspections, weighing more on the last inspection), staffing, hours of care (considering differences in residents' dependency levels in each center) and quality measures (including information on 15 different physical and clinical measures).

In Catalonia, no standardized classification of nursing homes is used based on indicators, although the Ministry of Social Rights of the Government of Catalunya carries out periodic inspections in all centers, evaluating the compliance within mandatory items to maintain operational dependencies. There is a division between 1- socio-health centers (which provide specialized care, medical and social care, mainly to ill elderly people but also, regardless of age, people with chronic disabling diseases, disabling developmental diseases, cognitive impairment, terminal illnesses, with functional rehabilitation needs or those who require continuous care or treatment), 2- assisted living centers (comprehensive care services, for elderly with impaired Activities of Daily Living, those with supervision needs and socio-familial situations that require home replacement, adapted to the degree of dependence of the users) and 3- home-residence services (temporary or permanent residential care services for elderly with a degree of sufficient autonomy for the Activities of Daily Living, which require a certain level of organization and personal support, with the main objective to facilitate a substitute environment of the home). In practice, residential homes and assisted living facilities can be considered together as same category centers. In Catalonia, nursing homes can be classified on the basis of two main variables: the size of the center and its management. As for the size of the residence, divisions are generally established every 25 or 50 beds in capacity. According to their size centers have more material requirements and staffing ratios according to current regulations; they are usually divided into centers with less than 50 beds, centers with between 50 and 150 beds, and centers with more than 150 beds [10]. According to the management of the center, the Government of Catalonia establishes the following distinctions: A- Administration owned centers (with directly public managed or with external management by a private operator); B- centers with some type of contract with the administration (collaborators: with collaborating beds; concerted: with agreed beds; centers with accredited beds for the linked financial benefit); C- unaccredited private centers (private centers without beds with public funding). Most centers with some type of contract with the administration have the same requirements according to the regulations and have several types of contracts at the same time (presenting concert beds, collaboration or linked financial benefits), so they are often considered as a specific group.

Studies of the first wave of COVID-19 seem to show that the virus is blind to the quality of residence. Even the best quality nursing homes can have a high number of cases

and deaths from COVID-19 and there seems to be no relationship between the five-star quality measures and having virus-positive residents at the center [6,9].

Evidence shows that the entry of the virus into the centers is not influenced by their quality and that the only influencing factor seem to be the prevalence of the virus in the community where it is located [2,6,10] influenced by communities with higher population density, lower socioeconomic resources or higher unemployment [2], predominantly urban [10] and, in the case of the United States, a higher proportion of African American population [2,10,11] or other ethnic minorities [2,4]. White et al. [9] and d'Abrams et al. [10] studies add the size of the nursing home, in addition to the prevalence in the community, as a predictor of the probability of outbreak [10] and mortality rate, where large residences would see an increased chance of being affected by the virus [2,9]. In small residences (smaller than 50 beds), however, the incidence of patients per center would be higher, probably due to the difficulty of isolating infected patients [10]. Liotta et al. [7] also find a direct relationship between a higher infection in people over the age of 80 and a higher percentage of beds in residences per inhabitant. Although this quality does not shield the homes from the entry of the virus [3,4,5,6,10] some evidences show [6] that its incidence and mortality is decreasing [2,11], probably because of the best logistical and personnel resources [2,5,9] in slowing down the contagion; while other studies [9] find no relation.

Regarding COVID-19 incidence in geriatric centers, there is still a lack of studies with a larger sample to analyze the influence nursing home's size and the public Administration contractual relationship.

Objectives: To analyze the cumulative incidence and mortality of COVID-19 in the first and second waves of the pandemic in Catalonia, in different types of nursing homes, with special reference to the size of the center and the contractual relationship with the Administration.

2. Methods

A retrospective observational analytical study of the incidence of COVID-19 in nursing homes in Catalonia is designed taking into account all official data from March 1st to December 10th 2020, differentiating the periods of the first wave (1 of March to July 31), period between waves (August 1 to September 30) and second wave (October 1 to December 10). Data: Government of Catalonia Transparency web portal, official COVID-19 register of all Catalan nursing homes. Univariate, bivariate and multivariate linear regression analysis, using software IBMTMSPSS[®] v.20 software. Variables: COVID-19 disease incidence cases (both suspected and diagnosed) and COVID-19 mortality (both suspected and diagnosed); to perform the stratified statistical analysis, the centers were divided by size into 3 groups (less than 50 beds, between 50 and 150, and more than 150) **Error! Bookmark not defined.** or into 5 groups (less than 25 beds, 25-50 beds, 50-100 beds, 100-15 beds and bigger than 150 beds); to analyze the influence of the contractual relationship with the Administration, the centers were subdivided into public, private concerted and non-accredited.

3. Results

The total number of residential centers listed in Catalonia is N=1.057 nursing homes, which represent a total of 63.682 residential beds (average=60,48, max=308, min=7, p-value=0,000). The area with more nursing homes' density is Barcelona and surroundings (28,4% of total centers), followed by Baix Llobregat (11,1%) and Vallès Occidental (10,3%).

According to its size (see **Error! Reference source not found.**), the three categories distribution of beds between the nursing homes is 52,1% of the centers are small-sized (less than 50 beds, n=550), 42,8% mid-sized (50-150 beds, n=452), and 5,0% are larger than 150 beds (n=53). Splitting all nursing homes in five size categories (see), 25,4% had less than 25 beds (n=268), 26,7% had 25-50 beds (n=282), 34,2% had 50-100 beds (n=361), 8,6% had 100-150 beds (n=91) and 5,0% had more than 150 beds (n=53).

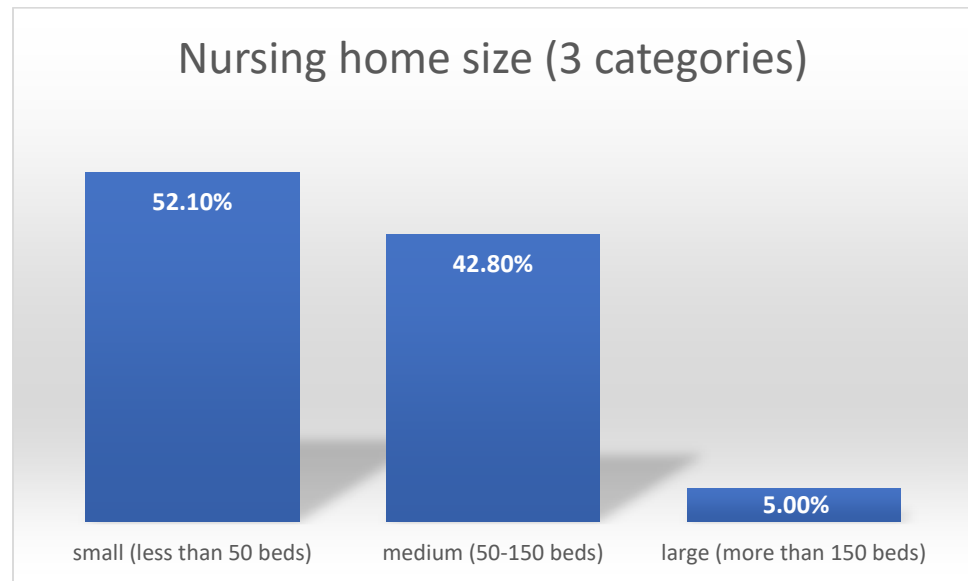


Figure 1. Nursing homes size distribution in Catalonia (3 size categories).

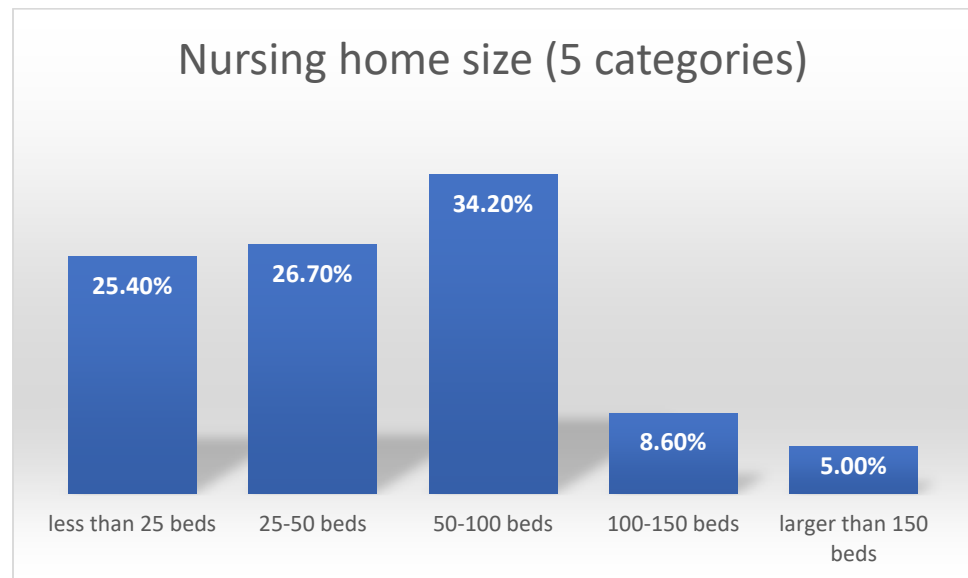


Figure 2. Nursing homes size distribution in Catalonia (5 size categories).

In terms of their relationship with the Administration (see **Error! Reference source not found.**), 6,0% are public centers ($n=63$, mean=82,54 beds in each center), whether publicly managed or privately managed, 20,6% are private centers without any agreement with the Administration (non-accredited, ($n=218$, mean=45 beds) and 73,1% are private centers with some type of contract with the Administration ($n=773$, mean=63 beds; ANOVA p -value=0,000). From March to July 2020, 3 nursing homes stopped their activity and closed their doors, all of them where centers with Administrations contract. The distribution of beds between the nursing homes (see **Error! Reference source not found.**) is as follows: 8,2% of beds are in publicly owned centers ($n=5.200$), 15,2% in private non-accredited centers ($n=9.691$) and 76,6% in subsidized centers or with Administration contracts ($n=48.766$, p -value=0,000).

Total occupation rate at the end of the first wave was 81,09% (standard deviation $sd=16,38$) and there was no correlation between occupation rate and size of the center (Pearson $r=-0.17$, p -value=0,000). When analyzing by categories nursing homes' size and occupation, small-sized and medium sized centers has slightly higher occupation (82,53% and 80,59%, respectively) than large-sized (70,62%) ones.

Analizing occupation rates at the end of the first wave with nursing homes' Administration contracts, we found no correlation between is centers are public owned, privately owned and with or without contract with the Administration (Pearson $r=-0,88$, $p\text{-value}=0.005$).

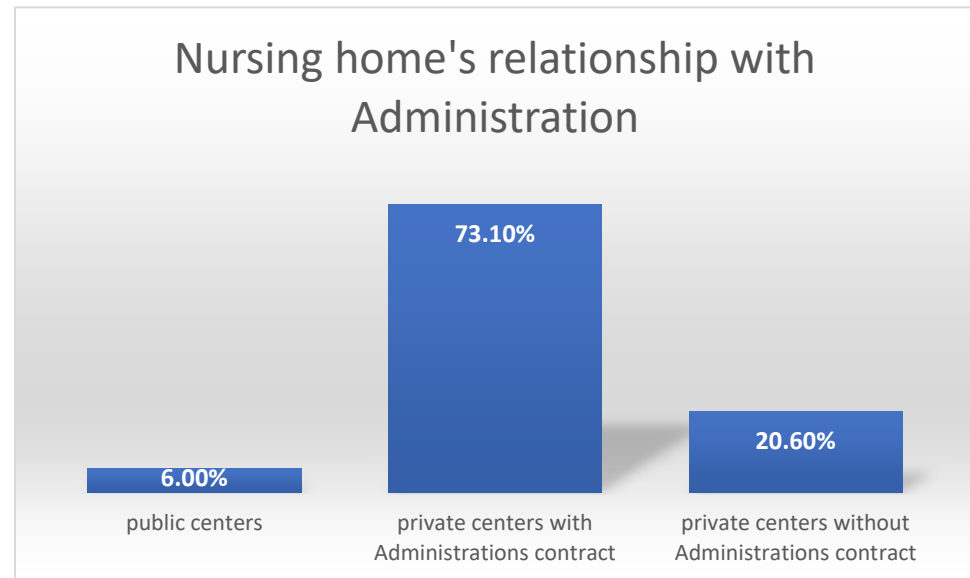


Figure 3. Nursing homes' Relationship with Administration in Catalonia.

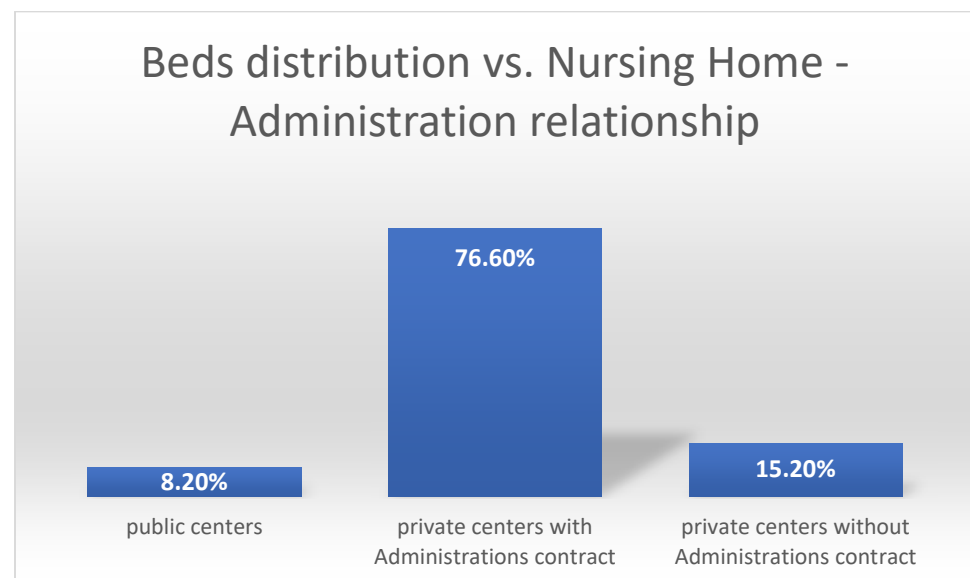


Figure 4. Beds distribution among nursing homes, according to Administration contracts.

COVID-19 first wave (5 months, March 1 to July 31, 2020) analysis: the total cumulative induction of COVID-19 in nursing homes throughout Catalonia was 21.370 cases (12.673 analytically confirmed and 8.697 presumptive clinical diagnosis), showing a total incidence of 33,55% of the 63.682 beds (pre-pandemic total occupation was about 100%). Reported COVID-19 mortality during the first wave was 5.010 people (2.351 confirmed and 2.660 deaths COVID-19 suspicious).

22% of the nursing homes ($n=233$) recorded no COVID-19 patients. By provider type, the lowest incidence of COVID-19 disease was in non-accredited centers (36,2% without any COVID-19 cases, $n=79$ from a 218 total), than the Administration concerted ones (19,3%, $n=149$ from the 773 total) and the publicly owned centers (7,9%, $n=5$ from the 63 total public centers, $p=0,000$). The centers with the fewest deaths number were also non-

accredited (78% without deaths, n=170), followed by concerted / Administration collaborators (56,8%, n=439) and those publicly owned by the Administration (41,3%, n=26, p=0,000). Depending on the size of the center (see **Error! Reference source not found.**), no COVID-19 patients were registered in 168 centers with less than 50 beds (30,5% of the 550 total small-sized nursing homes); 64 of centers with between 50 and 150 beds (14,2% of the 452 total middle-sized centers); and only 1 of the centers with more than 150 beds (1,9% of the 53 total large centers; p=0,000).

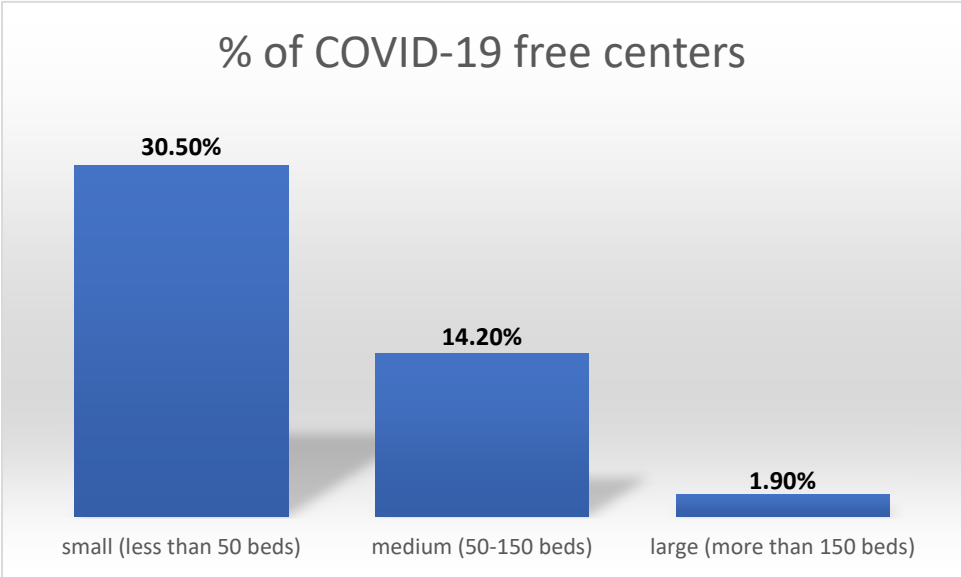


Figure 5. Percentage of nursing homes without any COVID-19 cases during the first wave, according to its size.

As for deaths, 60,2% of the centers (n=636 from the total 1.057 nursing homes) did not record any COVID-19 deaths from the disease during the first wave. By provider type, the lowest COVID-19 death rates was in non-accredited centers (78% with no reported deaths, n=170) followed by Administration concerted ones (56.8% with no reported deaths, n=439) and by publicly owned centers (41.3% with no reported deaths, n=26, p-value=0.000). In the three-categories nursing home stratification (see **Error! Reference source not found.**), 71.8% of the small-sized nursing homes reported no COVID-19 deaths during the first wave (n=395), 51.3% of themid-sized centers reported no COVID-19 deaths (n=232) and only 17% of large centers reported no COVID-19 deaths (n=9; p-value=0.000). Splitting nursing homes in a five size categories (see **Error! Reference source not found.**), did not report any COVID-19 deaths during this period 72,4% of the smaller than 25 beds centers (n=194), 71,3% of the 25-50 beds centers (n=201), 54,6% of the 50-100 centers (n=197), 38,5% of the 100-150 beds centers and 17.0% of the larger than 150 beds centers (p-value=0.000).

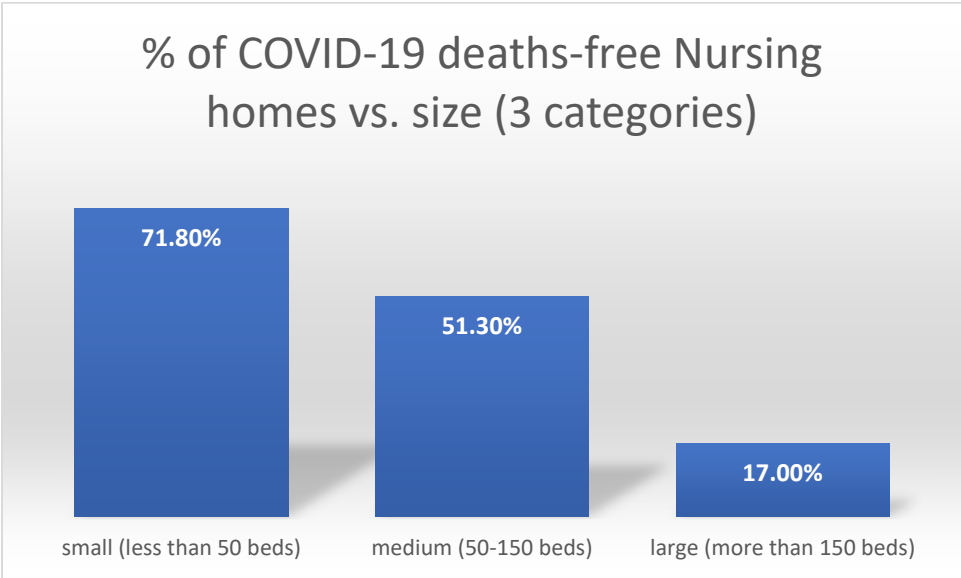


Figure 6. COVID-19 Death free nursing homes percentage according to its size (3 categories, first wave).

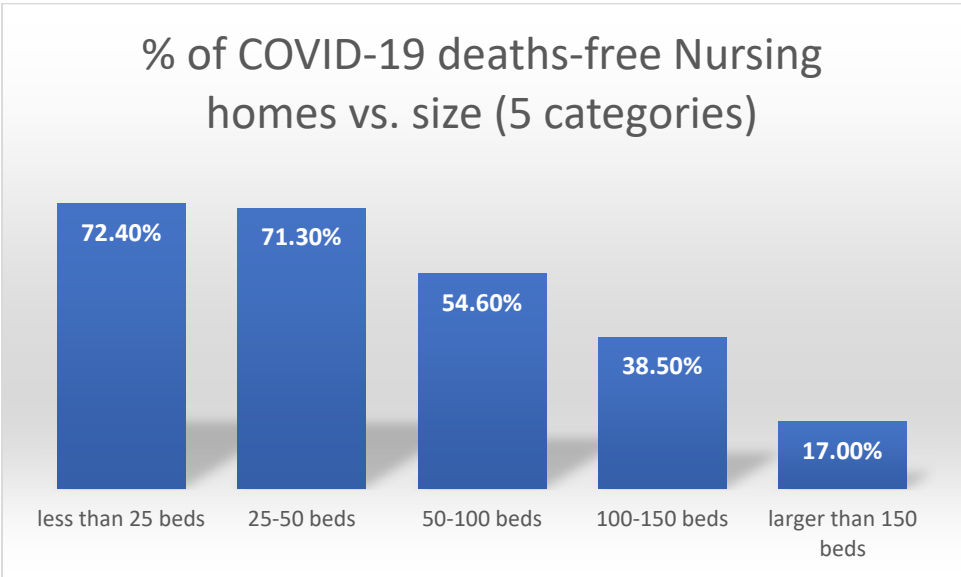


Figure 7. COVID-19 Death free nursing homes percentage according to its size (3 categories, first wave).

Of the 21.370 affected by covid-19 (adding confirmed and suspicious cases), 78.86% (n=16.847) were from Administration collaborating centers, 11.30% (n=1.958) from Administration owned centers and 4.37% (n=219) from non-accredited centers. Of the 5.010 deaths from covid-19 (adding confirmed and suspicious cases), 84.32% (n=4.222) were from Administration collaborating centers, 11.30% (n=566) from own centers and 4.37% (n=219) from non-accredited centers with more than 150 places.

Total COVID-19 incidence ratio (see **Error! Reference source not found.**) was 32.77%; by providers, incidence rate was 32.78% in non-accredited centers, 32,63% in Administration collaborating centers and 34,47% in Administration-owned centers, showing non statistically differences among the three categories in ANOVA analysis (p-value=0.963). Association measures show that in Administration owned centers incidence was 2% higher (square Eta p-value=0.037).

Total COVID-19 diagnostic/mortality ratio (see **Error! Reference source not found.**) was 6.95%; by providers, it was 3.22% in non-accredited centers, 7.72% in Administration collaborating centers and 9.67% in Administration-owned centers, showing statistically

differences among the three categories in ANOVA analysis (p-value=0.000). Association measures show that in Administration owned centers mortality was 2% higher than in Administration collaborating centers and 6.4% higher than in non-accredited nursing homes (square Eta p-value=0.000).

Table 1. Diagnostic/mortality rates and incidence (first COVID-19 wave) according to nursing homes providers.

Provider type		COVID-19 diagnostic/mortality rate (% of total occupied beds)	COVID19 incidence rate (% of total occupied beds)
Administration-owned centers	Mean	9,6745	34,4736
	N	63	63
	St. dev.	9,86569	31,73964
Administration collaborating centers	Mean	7,7268	32,6326
	N	772	772
	St. dev.	10,39271	45,15913
non-accredited centers	Mean	3,2187	32,7874
	N	204	205
	St. dev.	6,77762	71,66082
Total	Mean	6,9598	32,7746
	N	1039	1040
	St. dev.	9,93271	50,81235
ANOVA		P=0.000	P=0.963

Table 2. Diagnostic/mortality rates and incidence (first COVID-19 wave) according to nursing homes size (3 categories).

Nursing home size (3 Categories)		COVID-19 diagnostic/mortality rate (% of total occupied beds)	COVID19 incidence rate (% of total occupied beds))
Less than 50 beds	Mean	5,8348	31,8434
	N	540	540
	St. dev.	9,69980	57,22960
50-150 beds	Mean	7,7232	32,9381
	N	448	449
	St. dev.	10,01483	44,10422
More than 150 beds	Mean	11,9314	40,9409
	N	52	52
	St. dev.	9,58084	28,65439
Total	Mean	6,9531	32,7700
	N	1040	1041
	St. dev.	9,93028	50,78813

ANOVA	P=0.000	P=0.466
-------	---------	---------

Total COVID-19 incidence rate (see **Error! Reference source not found.**) was 32.78%; by center size, incidence was 31.84% in less than 50 beds centers, 32.94% in 50-150 beds centers and 40.94% in larger than 150 beds centers, showing non statistically differences among the three categories in ANOVA analysis (p-value=0.466). Association measures show that in larger centers incidence was 8% higher (square Eta p-value=0.001). Splitting nursing home by 5 size categories (see **Error! Reference source not found.**), smaller than 25 beds centers had a 32.76% incidence during the first COVID19 wave, 25-50 beds centers had 30,96%, 50-100 beds 31.91%, 100-150 beds 36,94% and larger than 150 beds centers had an incidence of 40,94% in ANOVA analysis, showing no statistical significance about incidence (p-value=0.661). Association measures show that in larger centers incidence was higher (square Eta p-value=0.024).

Total COVID-19 diagnostic/mortality ratio (see **Error! Reference source not found.**) was 6.95; by nursing home size, incidence was 5.83% in less than 50 beds centers, 7.72% in 50-150 beds centers and 11.93% in larger than 150 beds centers, showing statistically differences among the three categories in ANOVA analysis (p-value=0.000). Association measures show that in larger than 150 beds centers incidence was 4% higher than in medium-sized centers and 5.3% higher than in small-sized nursing homes (square Eta p-value=0.022). Splitting nursing home by 5 size categories (see **Error! Reference source not found.**), smaller than 25 beds centers had a 6.42% mortality during the first COVID19 wave, 25-50 beds centers had 5.26%, 50-100 beds 7.52%, 100-150 beds 8.51% and larger than 150 beds centers had a mortality rate of 11.93% in ANOVA analysis, showing statistical significance about mortality (the larger center associated with higher mortality, p-value=0.000). Association measures show that in larger centers mortality was higher (square Eta p-value=0.002).

Table 3. Diagnostic/mortality rates and incidence (first COVID-19 wave) according to nursing homes size (5 categories).

Nursing home size (5 Categories)		COVID-19 diagnostic/mortality rate (% of total occupied beds)	COVID19 incidence rate (% of total occupied beds)
Less than 25 beds	Mean	6,4269	32,7649
	N	264	264
	St. dev.	10,20372	52,06492
25-50 beds	Mean	5,2684	30,9620
	N	276	276
	St. dev.	9,17483	61,84968
50-100 beds	Mean	7,5223	31,9196
	N	357	358
	St. dev.	10,14922	46,05266
100-150 beds	Mean	8,5111	36,9450
	N	91	91
	St. dev.	9,48178	35,35009
More than 150 beds	Mean	11,9314	40,9409
	N	52	52
	St. dev.	9,58084	28,65439
Total	Media	6,9531	32,7700

N	1040	1041
Desv. tip.	9,93028	50,78813

Analyzing Pearson correlations among centers’ size and COVID we found no statistically relationship ($r=0.3$; $p\text{-value}=0.327$) in correlating COVID19 incidence, but there was a weak but significant correlation between centers’ size and mortality ($r=0.14$; $p\text{-value}=0.000$) showing higher mortality in larger nursing homes.

The multivariate regression analysis (see **Error! Reference source not found.**) shows that the Administration owned largest centers were the most affected (mean=61,50 affected) than medium-sized centers (mean=33,44 affected) and small-sized (mean=27,52 affected), while total incidence was 34.47% in administration owned centers. In the same sense in Administration collaborating centers, the larger the size of the center (large-sized: mean=41,59 affected; medium-sized: mean=34,56 affected; small-sized: mean=29,92 affected). In the same analysis, non-accredited centers behaved differently: the greatest impact occurred in centers with less than 50 beds (mean=37,38) and medium-sized (mean=23,72), while the larger ones showed much less impact (mean=3,69 affected, see **Error! Reference source not found.**). In terms of mortality, the multivariate regression analysis shows that the Administration owned largest centers had higher mortality (mean=13,45 deaths) than medium-sized centers (mean=10,83) and small-sized (mean=0,39 deaths). In the same sense, the larger the size of the center, the greater the size of the Administration collaborating centers (large-sized: mean=12,59 affected; medium-sized: mean=8,22 affected; small-sized: mean=6,73 affected). In the same analysis, non-accredited centers behaved differently: the greatest impact occurred in centers with less than 50 beds (mean=3,73 affected) and medium-sized (mean=2,14), while the older ones showed much less impact (mean=0,00 affected, see **Error! Reference source not found.**). These data show statistical significance (see **Error! Reference source not found.**) for the combination of the variables (provider type and center size vs. incidence or mortality) of: Pillai Trace, $p=0,036$; Wilks Lambda, $p=0,036$; Hotelling Trace, $p=0,036$ and Roy's Major Root, $p=0,016$.

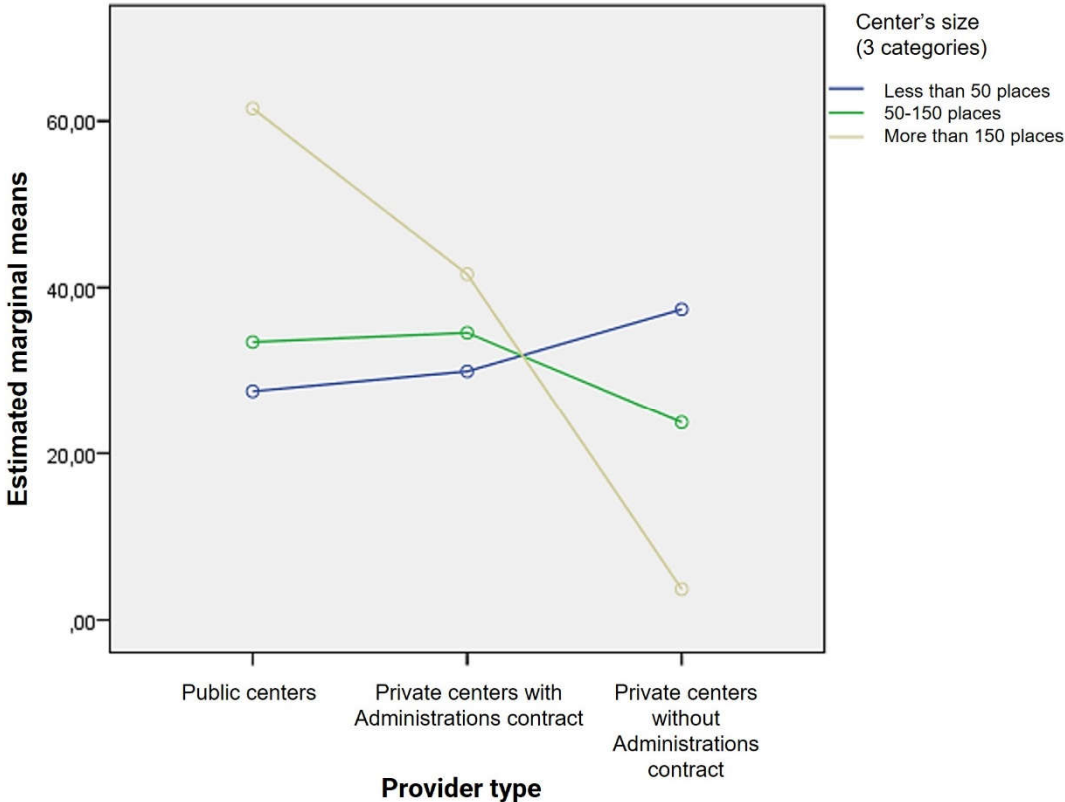


Figure 8. Estimated marginal means of percentage of involvement (incidence) of confirmed+suspected COVID-19 (% of total nursing home residents).

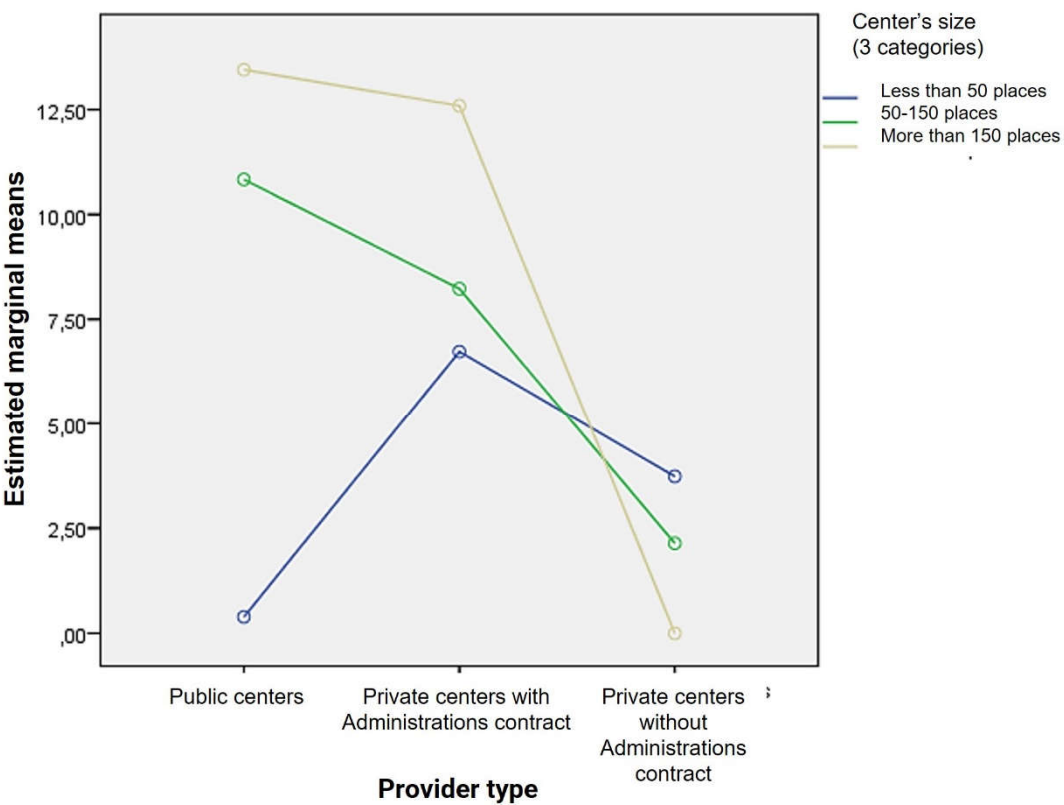


Figure 9. Estimated marginal means of percentage of mortality due to confirmed+suspected COVID-19 (% of total residents).

Table 4. Multivariate analysis, type and size of the centers vs. incidence and mortality.

Provider type		Nursing home size (3 categories)	Mean	St. Dev.	N
COVID19 incidence rate (% of total occupied beds))	Administration owned centers	Less than 50 beds	27,5194	30,27696	8
		50-150 places	33,4447	31,58766	51
		More than 150 beds	61,5014	30,49771	4
		Total	34,4736	31,73964	63
	Administration collaborating centers	Less than 50 beds	29,9214	44,50483	389
		50-150 places	34,5595	47,58129	338
		More than 150 beds	41,5962	27,44503	45
		Total	32,6326	45,15913	772
	Non-accredited centers	Less than 50 beds	37,3795	83,55885	142
		50-150 places	23,7192	29,87887	59
		More than 150 beds	3,6975	5,95191	3
		Total	32,9334	71,80653	204
	Total	Less than 50 beds	31,8506	57,28253	539
		50-150 places	33,0049	44,13076	448
		More than 150 beds	40,9409	28,65439	52
		Total	32,8033	50,82842	1039
COVID-19 diagnostic/mortality rate (% of total occupied beds)	Administration owned centers	Less than 50 beds	,3906	1,10485	8
		50-150 places	10,8346	10,02925	51
		More than 150 beds	13,4507	7,77909	4
		Total	9,6745	9,86569	63
	Administration collaborating centers	Less than 50 beds	6,7284	10,37399	389
		50-150 places	8,2282	10,32647	338
		More than 150 beds	12,5917	9,58685	45
		Total	7,7268	10,39271	772
	Non-accredited centers	Less than 50 beds	3,7347	7,40872	142
		50-150 places	2,1403	4,99683	59
		More than 150 beds	,0000	,00000	3
		Total	3,2187	6,77762	204
	Total	Less than 50 beds	5,8456	9,70554	539
		50-150 places	7,7232	10,01483	448
		More than 150 beds	11,9314	9,58084	52
		Total	6,9598	9,93271	1039

Table 5. Multivariate contrast values and significance.

Effect		Value	F	Hypotheses Gl	Error Gl	Sig.
Intersection	Pillai's trace	,056	30,543	2,000	1029,000	,000
	Wilks' Lambda	,944	30,543	2,000	1029,000	,000
	Hotelling's Trace	,059	30,543	2,000	1029,000	,000
	Major Root of Roy	,059	30,543	2,000	1029,000	,000
Provider_type_num	Pillai's trace	,013	3,445	4,000	2060,000	,008
	Wilks' Lambda	,987	3,451	4,000	2058,000	,008
	Hotelling's Trace	,013	3,458	4,000	2056,000	,008
	Major Root of Roy	,013	6,655	2,000	1030,000	,001
Provider_Size_3Categories	Pillai's trace	,009	2,410	4,000	2060,000	,047
	Wilks' Lambda	,991	2,413	4,000	2058,000	,047
	Hotelling's Trace	,009	2,416	4,000	2056,000	,047
	Major Root of Roy	,009	4,769	2,000	1030,000	,009
Provider_type_num * Provider_Size_3Categories	Pillai's trace	,016	2,069	8,000	2060,000	,036
	Wilks' Lambda	,984	2,069	8,000	2058,000	,036
	Hotelling's Trace	,016	2,069	8,000	2056,000	,036
	Major Root of Roy	,012	3,078	4,000	1030,000	,016

4. Discussion and Conclusions

Data show that publicly owned nursing homes are larger, those with Administration contracts tend to be middle-sized and private nursing homes in Catalonia tend to be smaller (ANOVA, p-value=0,000)

Part of the increase in mortality in nursing homes appears to have been shown to be due to the lack of provision of protective equipment to residents and center workers [2,5,7]. In Italy, the main cause could be that, as in Catalonia, until the outbreak of the COVID-19 pandemic, nursing homes in Italy were not considered health centers. Community coexistence, high contact activities [2,4,5,7,9,12,13], leaving the center to receive treatment for chronic diseases in hospitals or specialized centers [6], the need for assistance in Basic Daily Living Activities [2] and cognitive impairment in residents make preventive measures difficult (social distancing and hard mask) [4–6], and they are a risk factor in themselves [4]. Along with the high percentage of asymptomatic transmission (up to 74% in nursing home residents [14] and between 25% and 50% in workers) [2,3] and higher rate of false negatives in geriatric population [4], these factors may have played a major role in the expansion and severity of the outbreak in the residences [2,4,9,13]. This increase in severity, especially in people with severe mental illness, can be seen in a 30% increase in the chances of death or need for intensive care [4], where in a resident population over the age of 80 only 15% would survive with a greater disability [12]. Despite this data, Liotta et al. [7] shows that living independently has not brought an advantage in reducing the contagion in the elderly, probably due to the need to break the isolation of the home to perform the most essential activities that involve leaving home.

The possible lack of hygienic measures and disinfection of residences, 82% deficit in a review in the US between 2013 and 2017 [2], have been able to contribute to the spread of infection in environments where social distancing and other preventive measures are difficult to comply with [2,13]. Also, during the onset of the first wave, deaths that had occurred in nursing homes were not counted in COVID-19 mortality statistics or the criteria varied between communities or countries, resulting in an underestimation of this [3,8,10]. Some studies put deaths in nursing homes at more than 30% of the total in some European countries that did account for deaths in nursing homes [12,15], reaching 50% in Belgium [4]. In the United States, the numbers fluctuate: 40-50% of registered deaths have occurred in long-stay centers [5,10], reaching up to 80% in some states [2], with confirmed or suspected cases in 92% of the residences that have provided data to the country during the first wave [2].

In the first wave in Catalonia, of the 1,057 centers analyzed, 22% did not register cases and in 60% there were no deaths due to COVID-19, results in line with those found by Kennelly et al. in the analysis of residencies in Ireland, with three-quarters of the institutions analyzed by outbreak [3]. However, these results seem to contrast with those found in US residences where according to some publications almost 65% of the centers studied did not present any case of COVID-19 [2,11].

Residences without concert / collaboration with the Generalitat and with fewer beds showed a lower cumulative incidence and mortality due to COVID-19 during the first wave. The results presented in this study follow the line of those shown in the cross-sectional study by White et al. where residences with more beds had a higher probability of outbreak and a higher mortality rate [9], relationship also established in other studies [2,10,11]. In some cases, this increase in incidence is also seen in residences with a lower rate of nursing professionals [2] as well as an increase in the lethality rate in residences with lower professional / resident ratios, from 52.0% to 10.9% with ratios <1 and >2 respectively [3] others indicate the opposite [9]. In contrast to the results obtained in the study presented, the research conducted by He et al., In residences in California, highlights a higher incidence and mortality of COVID-19 in private residences (for profit) compared to non-private ones (not-for-profit) or managed by the government [2,11], with an OR of 1.49 and 1.69 respectively [11], results consistent with other studies [10], where also more probability of some case of COVID-19 in independent nursing homes (no-chain) are observed [10] or in Irish residences where 80.1% of those who suffered an outbreak were private, although the proportion of residents with COVID-19 was higher in public institutions [3].

Increased morbidity and mortality in long-stay centers across Europe and the United Kingdom have been reported, despite the implementation of specific control measures in these centers. This reflects the need to implement strict and well-defined risk assessment measures in all residents [1]. Asymptomatic transmission has played a less important role in the spread of the virus to "late outbreaks" as a result of performing PCR control or "mass-testing" on both residents and workers [3].

Despite efforts to promote good care, many institutionalized older adults (IOA) experience elevated neglectful conditions and reduced person-centered care approaches. Personal factors may play a significant role in good care. Management support offers a promising mechanism to promote good care among nursing home professionals [16]. This epidemiological situation has direct and indirect consequences for the mental health of residents in the centers. On the one hand, social or physical isolation or distancing is proving to be essential in controlling the spread of the virus; however, the consequences for mental health and quality of life, both in the short and long term, are unquestionable [17]. These situations become more relevant in especially vulnerable groups, such as people in nursing homes and children, reporting an increase in anxiety, depression, feelings of isolation [13,17]. and child abuse [17]. This can be likened to the SARS epidemic, which recorded up to 65% of patients who developed psychiatric morbidity (major depression (15% up to 30 months post-illness), anxiety, phobias, psychosis). , data that can be taken into account due to the obvious parallels [18]. In the case of COVID-19, some studies [18] show an increase in the incidence of depression among residents leading to states of immobility, agitation, apathy or anorexia that are especially alarming in patients with multiple pathologies and associated morbidity, as is the case with a high percentage of residents [5], up to 90% in some studies [4]. On the other hand, as a direct consequence of SARS-CoV-2 infection, evidence shows that in some cases, infected people with previous cognitive impairment (dementia) may see increased cognitive loss [4]. It is also important to consider the emotional state of affairs of the workers of these centers and the relatives of the nursing home residents [6].

The implementation of the use of digital technology in both the social and medical fields (visits by mental health staff or support groups) are considered as possible solutions to the negative consequences of the health situation with respect to mental health [17].

References

1. European Centre for Disease Prevention and Control. Increase in fatal cases of COVID-19 among long-term care facility residents in the EU/EEA and the UK. 19 November 2020. ECDC: Stockholm; 2020.
2. Sugg MM, Spaulding TJ, Lane SJ, Runkle JD, Harden SR, Hege A, Iyer LS. Mapping community-level determinants of COVID-19 transmission in nursing homes: A multi-scale approach. *Sci Total Environ*. 2021 Jan 15;752:141946.
3. Kennelly SP, Dyer AH, Noonan C, Martin R, Kennelly SM, Martin A, O'Neill D, Fallon A. Asymptomatic carriage rates and case-fatality of SARS-CoV-2 infection in residents and staff in Irish nursing homes. *Age Ageing*. 2020 Sep 28;afaa220.
4. Livingston G, Rostamipour H, Gallagher P, Kalafatis C, Shastri A, Huzzey L, Liu K, Sommerlad A, Marston L. Prevalence, management, and outcomes of SARS-CoV-2 infections in older people and those with dementia in mental health wards in London, UK: a retrospective observational study. *Lancet Psychiatry*. 2020 Dec;7(12):1054-1063.
5. Abbasi J. "Abandoned" Nursing Homes Continue to Face Critical Supply and Staff Shortages as COVID-19 Toll Has Mounted. *JAMA*. 2020 Jul 14;324(2):123-125.
6. Ouslander JG, Grabowski DC. COVID-19 in Nursing Homes: Calming the Perfect Storm. *J Am Geriatr Soc*. 2020 Oct;68(10):2153-2162.
7. Liotta G, Marazzi MC, Orlando S, Palombi L. Is social connectedness a risk factor for the spreading of COVID-19 among older adults? The Italian paradox. *PLoS One*. 2020 May 21;15(5):e0233329.
8. Ciminelli G, Garcia-Mandicó S. COVID-19 in Italy: An Analysis of Death Registry Data. *J Public Health (Oxf)*. 2020 Sep 16:fdaa165. doi: 10.1093/pubmed/fdaa165. Epub ahead of print.
9. White EM, Kosar CM, Feifer RA, Blackman C, Gravenstein S, Ouslander J, Mor V. Variation in SARS-CoV-2 Prevalence in U.S. Skilled Nursing Facilities. *J Am Geriatr Soc*. 2020 Oct;68(10):2167-2173.
10. Abrams HR, Loomer L, Gandhi A, Grabowski DC. Characteristics of U.S. Nursing Homes with COVID-19 Cases. *J Am Geriatr Soc*. 2020 Aug;68(8):1653-1656.
11. He M, Li Y, Fang F. Is There a Link between Nursing Home Reported Quality and COVID-19 Cases? Evidence from California Skilled Nursing Facilities. *J Am Med Dir Assoc*. 2020 Jul;21(7):905-908.
12. Lynn J. Playing the Cards We Are Dealt: COVID-19 and Nursing Homes. *J Am Geriatr Soc*. 2020 Aug;68(8):1629-1630.
13. Wang J, Yang W, Pan L, Ji JS, Shen J, Zhao K, Ying B, Wang X, Zhang L, Wang L, Shi X. Prevention and control of COVID-19 in nursing homes, orphanages, and prisons. *Environ Pollut*. 2020 Nov;266(Pt 1):115161.
14. Dora A.V., Winnett A., Jatt L.P., et al. (2020). Universal and serial laboratory testing for SARS-CoV-2 at a Long-term care skilled nursing facility for Veterans — Los Angeles, California, 2020. *MMWR Morb. Mortal. Wkly Rep*. 2020;69:651–655.
15. The Economist. The Impact of COVID-19 On Care Homes. London: The Economist Group, 2020.
16. López J, Pérez-Rojo G, Noriega C, Velasco C. Personal and Work-Related Factors Associated with Good Care for Institutionalized Older Adults. *Int J Environ Res Public Health*. 2021 Jan 19;18(2):E820.
17. Galea S, Merchant RM, Lurie N. The Mental Health Consequences of COVID-19 and Physical Distancing: The Need for Prevention and Early Intervention. *JAMA Intern Med*. 2020 Jun 1;180(6):817-818.
18. Louw A. Letter to the editor: chronic pain tidal wave after COVID-19: are you ready? *Physiother Theory Pract*. 2020 Dec;36(12):1275-1278.