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Pattern of SARS-CoV-2 infection among dependant elderly residents living in long-term care facilities in Marseille, France, March–June 2020

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ABSTRACT

Objectives: This study aimed to report the results of SARS-CoV-2 PCR-based screening campaigns conducted on dependent elderly residents (compared with staff members) in long-term care facilities (LTCFs) in Marseille, France, and the follow-up of positive cases.

Methods: Data from 1691 elderly residents and 1000 members of staff were retrospectively collected through interviewing the medical teams in 24 LTCFs and using the hospitals' electronic health recording systems.

Results: Elderly residents were predominantly female (64.8%) with a mean age of 83.0 years. SARS-CoV-2 detection among residents (226, 13.4%) was significantly higher than among staff members (87, 8.7%) ($P < 0.001$). Of the 226 infected residents, 37 (16.4%) were detected on a case-by-case basis due to their COVID-19 symptoms and 189 (83.6%) were detected through mass screening. Most (77.0%) had possible COVID-19 symptoms, including respiratory symptoms and signs (44.5%) and fever (46.5%); 23.0% were asymptomatic. A total of 116 (51.4%) patients received a course of oral hydroxychloroquine and azithromycin (HCQ-AZM) for ≥ 3 days; 47 (20.8%) died. Through multivariate analysis, the death rate was positively associated with being male (30.7% vs. 14.0%, OR = 3.95, $P = 0.002$), aged > 85 years (26.1% vs. 15.6%, OR = 2.43, $P = 0.041$) and receiving oxygen therapy (39.0% vs. 12.9%, OR = 5.16, $P < 0.001$)

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and negatively associated with being diagnosed through mass screening (16.9% vs. 40.5%, OR = 0.20, $P = 0.001$) and receiving HCQ-AZM treatment ≥ 3 days (15.5% vs. 26.4%, OR = 0.37, $P = 0.02$).

Conclusion: The high proportion of asymptomatic COVID-19 patients and independent factors for mortality suggest that early diagnosis and treatment of COVID-19 patients in LTCFs may be effective in saving lives.

1. Introduction

As of 02 June 2020, 10 350 elderly residents living in long-term care facilities (LTCFs) or medical-social establishments in France had died from coronavirus disease (COVID-19) (27.6% fatality rate), accounting for 55.6% of COVID-19 deaths in France [1]. Similar pictures have also been reported in many European countries [2] and worldwide [3]. The prevalence of chronic conditions such as cardiovascular diseases, hypertension and diabetes mellitus is high among elderly people living in LTCFs; COVID-19 in this population may therefore have severe outcomes with a high mortality rate [2,4,5]. Other drivers of mortality among elderly people living in LTCFs already include type of facility, the number of people visiting the facilities during the week prior to lockdown, staff ratios [3], and lagged infection in staff members [6].

The treatment of COVID-19 has been the subject of widespread controversy, particularly regarding to the use of hydroxychloroquine (HCQ) [7]. It appears that some of the elements of the controversy are the heterogeneity of protocols using HCQ, with doses ranging from 800–1200 mg per day, the duration of treatment, whether or not it is combined with azithromycin (AZM), and the stage of the disease at which patients are treated. It can be considered that there is a purely viral phase of the disease, with a more or less strong immune response, which can become predominant, in what has been referred to as the cytokine storm, followed in a number of cases by necrotic lesions, linked to pulmonary infarctions [8]. Furthermore, mortality depends very significantly on age; therefore, almost all deaths in Europe have been among people aged > 60 years, with > 50% in people aged > 85 years [9]. Under these conditions it is very difficult to carry out comparative studies addressing the effect of HCQ on COVID-19-associated deaths. Very few randomised studies have been conducted and their interpretations have also led to heated debate. To assist the debate, it is believed that it may be important to assess whether there is a clear reduction in mortality in the most at-risk groups.

In Marseille, over a period of approximately two months, this study was able to test and treat COVID-19 patients in LTCFs with a combination of HCQ-AZM, as has been described on several occasions [8,10–12]. The objective of this study was to estimate the prevalence of SARS-CoV-2 carriage among elderly residents and staff members working in 24 LTCFs in Marseille, France. It also aimed to estimate the fatality among elderly residents treated in these LTCFs and informally compare it with the fatality of people in these LTCFs who were not treated and the general fatality of people in LTCFs in France.

2. Methods

2.1. Setting, study design and population

SARS-CoV-2 cross-sectional mass screening campaigns were conducted among residents and staff members from 24 LTCFs in Marseille, between 24 March and 02 June 2020. In some centres, screening campaigns were conducted following the diagnosis of confirmed COVID-19 cases in symptomatic patients who were sampled on a case-by-case strategy. In other centres, screening campaigns were systematically conducted. In all cases, screening campaigns were conducted following a request from the directors and medical staff of the LTCFs. Nasopharyngeal samples were processed for SARS-CoV-2 PCR testing at the Institut Hospitalo-Universitaire (IHU) Méditerranée Infection at Assistance Publique-Hôpitaux de Marseille (AP-HM), as previously described [13] or in private laboratories in Marseille, in some cases. Residents who tested positive were: i) treated at their LTCFs by local medical staff only; ii) treated at their LTCFs in coordination with the AP-HM Home Hospitalisation Unit (HHU); iii) admitted to the IHU (day-care hospital or conventional units); or iv) transferred to the AP-MH Intensive Care Unit (ICU). For confirmed cases, information on demographics, chronic medical conditions, COVID-19 treatment and clinical data – including fever, asthenia, anorexia and weight loss, respiratory symptoms and signs (cough, rhinorrhoea, dyspnoea, chest pain, acute respiratory distress syndrome) and death – were retrospectively collected from interviews with the medical team of 24 LTCFs and the electronic health recording systems of the AP-HM.

2.2. Statistical methods

Statistical procedures were performed using STATA 11.1. Pearson's χ^2 or Fisher's exact tests to compare between-group differences of patients, where appropriate. A two-sided P-value of < 0.05 was considered to be statistically significant. A separate logistic regression analysis was used to identify independent risk factors for SARS-CoV-2 death prevalence among all elderly residents testing positive for SARS-CoV-2. The results were presented by percentages and odds ratios (OR) with 95% confidence intervals (95% CI). The initial model included variables presenting $P < 0.2$. The stepwise regression procedure and likelihood-ratio tests were applied to determine the final model.

3. Results

Over the study period, 1691 elderly residents and 1000 staff members were tested (Table 1). For residents, the sex ratio (male to female) was 1:1.8 and the mean age (± standard derivation [SD]) was 83.0 (± 10.6) years (range 50–106 years). For staff members, the sex ratio was 1:3.5 and the mean age (± SD) was 40.8 (± 12.8) years (range 18–87 years). It should be noted that two religious staff members at one LTCF were aged 75 years and 87 years, respectively.

Overall, 313 participants (of 2691, 11.6%) were confirmed positive for SARS-CoV-2. The prevalence among residents (226 of 1691, 13.4%) was significantly higher than among staff members (87 of 1000, 8.7%; $P < 0.001$). With regard to the housing facilities, at least one individual was positive in 11/24 (45.8%) centres, with prevalence of SARS-CoV-2 detection ranging 0–57.6% among residents and 0–24.1% among staff members (Table 1). The fatality rate among residents was 20.8%, while no deaths occurred among staff members ($P < 0.001$).

Table 1
SARS-CoV-2 testing among residents and staff members at 24 long-term care facilities in Marseille, France, 27 March–2 June 2020.

Characteristics	Residents				Staff members					Total	
Total	Date of mass testing	No. tested 1691	No. (%) positive 226 (13.4)	No. (%) deaths among positive cases (fatality rate) 47 (20.8)	No. tested 1000	No. (%) positive 87 (8.7)	No. (%) deaths among positive cases (fatality rate) 0 (0)	*P*-value[1] < 0.001	*P*-value[2] < 0.001	No. tested 2691	No. (%) positive 313 (11.6)
Centre (26 91)											
01	01 April, 08 April, 19 April	99	57 (57.6)	17 (29.9)	83	20 (24.1)	0 (0)	0.002	0.04	182	77 (42.3)
02	08 April, 19 April, 20 May	112	50 (44.6)	9 (18.0)	71	17 (24.0)	0 (0)	0.007	0.053	183	67 (36.6)
03	20 April, 26 April, 04 May, 11 May, 18 May, 25 May, 02 June	52	23 (44.2)	2 (8.7)	35	7 (20.0)	0 (0)	0.002	N/A	87	30 (34.5)
04	06 April, 21 April	89	24 (27.0)	8 (33.3)	108	12 (11.1)	0 (0)	0.007	0.03	197	36 (18.3)
05	08 April, 29 April	37	10 (27.1)	3 (30.0)	32	1 (3.1)	0 (0)	0.035	N/A	69	11 (16.0)
06	08 April, 17 April, 22 April	230	45 (18.0)	7 (15.6)	180	15 (8.3)	0 (0)	0.002	0.18	410	60 (14.9)
07	02 Avril, 27 April, 25 May	81	8 (9.9)	0 (0)	57	11 (19.3)	0 (0)	0.18	N/A	138	19 (13.8)
08	13 April, 06 May	77	7 (9.1)	1 (14.3)	24	1 (4.2)	0 (0)	0.67	N/A	101	8 (7.9)
09	21 April	54	0 (0)	N/A	44	3 (6.8)	0 (0)	0.08	N/A	98	3 (3.1)
10	23 April	46	1 (2.2)	0 (0)	12	0 (0)	N/A	N/A	N/A	58	1 (1.7)
11	15 April	118	1 (0.9)	0 (0)	60	0 (0)	N/A	N/A	N/A	178	1 (0.6)
12	15 April	66	0 (0)	N/A	18	0 (0)	N/A	N/A	N/A	84	0 (0)
13	28 April	96	0 (0)	N/A	39	0 (0)	N/A	N/A	N/A	135	0 (0)
14	30 April	45	0 (0)	N/A	12	0 (0)	N/A	N/A	N/A	57	0 (0)
15	17 April	64	0 (0)	N/A	27	0 (0)	N/A	N/A	N/A	91	0 (0)
16	22 April	48	0 (0)	N/A	19	0 (0)	N/A	N/A	N/A	67	0 (0)
17	25 April	61	0 (0)	N/A	29	0 (0)	N/A	N/A	N/A	90	0 (0)
18	15 April	52	0 (0)	N/A	18	0 (0)	N/A	N/A	N/A	70	0 (0)
19	27 April	32	0 (0)	N/A	24	0 (0)	N/A	N/A	N/A	56	0 (0)
20	27 April	29	0 (0)	N/A	15	0 (0)	N/A	N/A	N/A	44	0 (0)
21	24 April	25	0 (0)	N/A	11	0 (0)	N/A	N/A	N/A	36	0 (0)
22	20 April	53	0 (0)	N/A	22	0 (0)	N/A	N/A	N/A	75	0 (0)
23	14 April	100	0 (0)	N/A	52	0 (0)	N/A	N/A	N/A	152	0 (0)
24	24 April	25	0 (0)	N/A	8	0 (0)	N/A	N/A	N/A	33	0 (0)

(*continued on next page*)

Table 1 (*continued*)

Characteristics	Residents				Staff members					Total	
	Date of mass testing	No. tested	No. (%) positive	No. (%) deaths among positive cases (fatality rate)	No. tested	No. (%) positive	No. (%) deaths among positive cases (fatality rate)	*P*-value[1]	*P*-value[2]	No. tested	No. (%) positive
Total		**1691**	**226 (13.4)**	**47 (20.8)**	**1000**	**87 (8.7)**	**0 (0)**	**< 0.001**	**< 0.001**	**2691**	**313 (11.6)**
Sex (2471)											
Female, n (%)		1069 (64.8)	135 (12.6)	19 (14.1)	646 (77.7)					1705 (69.0)	
Male, n (%)		581 (35.2)	91 (15.7)	28 (30.8)	185 (22.3)					766 (31.0)	
Age (years) (2556)											
Mean ± SD		83.0 ± 10.6	83.4 ± 10.6	86.8 ± 10.2	40.8 ± 12.7					68.3 ± 23.1	
Range (min–max)		50–106	56–103	59–103	18–87					18–106	
18–34, n (%)		0 (0)	N/A	N/A	326 (36.4)					326 (12.8)	
35–49, n (%)		0 (0)	N/A	N/A	292 (32.6)					292 (11.4)	
50–59, n (%)		34 (2.1)	3 (8.8)	1 (33.3)	236 (25.4)					270 (10.6)	
60–69, n (%)		189 (11.4)	25 (13.2)	3 (12.0)	38 (4.2)					227 (8.9)	
70–79, n (%)		348 (21.0)	46 (13.2)	5 (10.9)	1 (0.1)					349 (13.7)	
80–89, n (%)		552 (33.2)	78 (14.1)	16 (20.5)	1 (0.1)					553 (21.6)	
90–99, n (%)		505 (30.3)	67 (13.3)	19 (28.4)	0 (0)					505 (19.8)	
> 99, n (%)		34 (2.1)	7 (20.6)	3(42.9)	0 (0)					34 (1.3)	

Abbreviation: N/A, not applicable.

[1] Comparison of positive testing prevalence between resident group and staff member group.

[2] Comparison of fatality rates between infected resident group and infected staff member group. [3]Number of individuals for whom data were available.

Table 2

Comorbidities, symptoms and signs, diagnostic and therapeutic management among 226 elderly residents testing positive for SARS-CoV-2.

Parameters	n (%)
Comorbidities (159) [1]	
Hypertension	63 (39.6)
Cardiovascular diseases (other than hypertension)	59 (37.1)
Dementia	46 (28.9)
Mental disorder	39 (23.6)
Diabetes mellitus	25 (15.7)
Chronic lung diseases	19 (12.0)
Stroke	17 (10.7)
Cancer	15 (9.4)
Chronic neurological disorder	12 (7.6)
Obesity	7 (4.4)
Chronic kidney diseases	7 (4.4)
Asthma	3 (1.9)
Symptoms and signs (200)	
Respiratory symptoms and signs	89 (44.5)
Fever	93 (46.5)
Asthenia, anorexia, weight loss	21 (10.5)
No COVID-19 symptoms	46 (23.0)
Circumstances of diagnosis (226)	
Case-by-case testing in patients with COVID-19 symptoms	37 (16.4)
Mass testing	189 (83.6)
Medical management of patients (226)	
Managed at LTCFs by local medical staff only	62 (27.4)
Managed at LTCFs in coordination with the HHU	117 (51.8)
Admitted to IHU	16 (7.1)
Transferred ICU	31 (13.7)
HCQ-AZM therapy (226)	
At least a 3-day course	116 (51.4)
2-day course	1 (0.4)
HCQ alone	1 (0.4)
AZM alone	37 (16.4)
No HCQ, no AZM	71 (31.4)
HCQ-AZM therapy at least a 3-day course according to the housing facilities (226)	
Centre 07, n/N (%)	7/8 (87.5)
Centre 01, n/N (%)	39/50 (78.0)
Centre 02, n/N (%)	43/57 (75.4)
Centre 05, n/N (%)	4/10 (40.0)
Centre 06, n/N (%)	14/45 (31.1)
Centre 04, n/N (%)	4/23 (17.3)
Centre 03, n/N (%)	4/24 (16.7)
Centre 08, n/N (%)	1/7 (14.3)
Centre 10, n/N (%)	0/1 (0)
Centre 11, n/N (%)	0/1 (0)
Oxygen therapy (199)	59 (29.7)
Ceftriaxone or ertapenem therapy (199)	63 (31.6)
Low-molecular-weight heparin therapy (199)	24 (12.1)

Abbreviations: HCQ, hydroxychloroquine; AZM, azithromycin; HHU, Home Hospitalisation Unit; IHU, Institut Hospitalo-Universitaire; ICU, Intensive Care Unit; LTCFs, long-term care facilities

[1] Number of individuals for whom data were available.

3.1. Characteristics of 226 elderly residents testing positive for SARS-CoV-2

Of the 226 SARS-CoV-2-positive elderly residents, 37 were diagnosed on a case-by-case basis through selected sampling of patients with COVID-19 symptoms, and 189 (83.4%) were detected through mass screening. Regarding comorbidities, the most frequent chronic condition was hypertension (39.6%), followed by other cardiovascular diseases (37.1%), dementia (28.9%) and other mental disorders (23.6%). In terms of clinical findings, 77.0% had possible COVID-19 symptoms, including respiratory symptoms and signs (44.5%) and fever (46.5%); 23.0% had no COVID-19 symptoms, representing 24.8% (40/161) of individuals tested through mass screening (Table 2).

When it came to therapeutic management, 62 (27.4%) patients were managed within their LTCFs by local medical staff only, 117 (51.8%) were managed within their LTCFs in collaboration with the

Table 3
Characteristics of group receiving HCQ-AZ for at least 3 days and untreated group.

Characteristics		Patient receiving HCQ-AZ ≥ 3 days N = 116	Patient not receiving HCQ-AZ ≥ 3 days N = 110	*P*-value
Demographic factors (226) [1]				
Gender	Female, n (%)	70 (60.3)	65 (59.1)	0.85
	Male, n (%)	46 (39.7)	45 (40.9)	
Age (years)[2]	50–85, n (%)	66 (56.9)	49 (44.5)	0.07
	> 85, n (%)	50 (43.1)	61 (55.5)	
Chronic conditions (159)				
Cardiovascular diseases	No, n (%)	51 (62.2)	49 (63.6)	0.85
	Yes, n (%)	31 (37.8)	28 (36.4)	
Hypertension	No, n (%)	46 (56.1)	50 (64.9)	0.26
	Yes, n (%)	36 (43.9)	27 (35.1)	
Dementia	No, n (%)	61 (74.4)	52 (67.5)	0.34
	Yes, n (%)	21 (25.6)	25 (32.5)	
Mental disorder	No, n (%)	61 (74.4)	59 (76.6)	0.74
	Yes, n (%)	21 (25.6)	18 (23.4)	
Diabetes mellitus	No, n (%)	69 (84.1)	65 (84.4)	0.96
	Yes, n (%)	13 (15.9)	12 (15.6)	
Chronic lung diseases	No, n (%)	72 (87.8)	68 (88.3)	0.92
	Yes, n (%)	10 (12.2)	9 (11.7)	
Stroke	No, n (%)	69 (84.2)	73 (94.8)	0.04
	Yes, n (%)	13 (15.8)	4 (5.2)	
Cancer	No, n (%)	74 (90.2)	70 (90.9)	0.86
	Yes, n (%)	8 (9.8)	7 (9.1)	
Chronic neurological disorder	No, n (%)	76 (92.7)	71 (92.2)	0.9
	Yes, n (%)	6 (7.3)	6 (7.8)	
Circumstances of diagnosis (226)	Case-by-case testing in patients with COVID-19 symptoms, n (%)	23 (19.8)	14 (12.7)	0.1
	Mass testing, n (%)	93 (80.2)	96 (87.3)	
Facility management of patients (226)[3]	In LTCFs only	0 (0)	62 (56.4)	N/A
	Other	116 (100)	48 (43.7)	
Oxygen therapy (199)	No, n (%)	79 (68.1)	61 (73.5)	0.4
	Yes, n (%)	37 (31.9)	22 (26.5)	
Ceftriaxone or ertapenem therapy (199)	No, n (%)	81 (69.8)	55 (66.3)	0.59
	Yes, n (%)	35 (30.2)	28 (33.7)	
Low-molecular-weight heparin therapy (199)	No, n (%)	98 (84.5)	77 (92.8)	0.08
	Yes, n (%)	18 (15.5)	6 (7.2)	

Abbreviations: HCQ, hydroxychloroquine; AZM, azithromycin; NA, Not applicable; LTCFs, long-term care facilities.
[1] Number of individuals for whom data were available.
[2] Median of the variable was used for analysis.
[3] Indication of HCQ-AZ treatment was compulsorily administrated in coordination with hospital.

HHU, 16 (7.1%) were admitted to IHU, and 31 (13.7%) were transferred to ICU. Overall, 116 (51.4%) patients received an oral HCQ (200 mg three times daily for 10 days) and AZM (500 mg on day 1 followed by 250 mg daily for the next four days) for at least three days and were monitored as described in previous studies [10–12]. Of the 110 others (48.6%), one (0.4%) received a two-day course of HCQ-AZM, one (0.4%) received HCQ alone, 37 (16.4%) received AZM alone, and 71 (31.4%) did not receive either drug. The prevalence of HCQ-AZM treatment for at least three days ranged from 0–87.5% according to the housing facilities. Other treatments are described in Table 2. A total of 179 patients survived (79.2%) and 47 (20.8%) died. The baseline characteristics of the 116 patients who received HCQ-AZM treatment for at least three days compared with 110 patients who did not receive the treatment were largely similar (Table 3). A higher proportion of patients with a history of stroke was observed in the treated group (15.8%) compared with the untreated group (5.2%, $P = 0.04$).

Table 4 shows the fatality rate among elderly residents with SARS-CoV-2 infection, according to demographics, chronic conditions, circumstance of diagnosis, type of medical management of patients, use of HCQ-AZM, and housing facility effect according to prevalence of HCQ-AZM treatment for at least three days in each housing facility. Under univariate analysis, death from COVID-19 was significantly associated with being male. In addition, patients who were diagnosed on a case-by case basis due to their COVID-19 symptoms were more likely to die (40.5%) than those diagnosed through systematic screening (16.9%). Finally, patients who received oxygen treatment were more likely to die (39.0%) than those who did not receive such a treatment (12.9%). In contrast, patients who received HCQ-AZM treatment for at least three days were less likely to die (15.5%) than those who did not receive such treatment (26.4%). Through multivariate analysis, the death rate was positively associated with being male (30.7% vs. 14.0%, OR = 3.95 [1.65–9.44]; $P = 0.002$), aged > 85 years (26.1% vs. 15.6%, OR = 2.43 [1.04–5.69]; $P = 0.041$) and receiving oxygen therapy (OR = 5.16 [2.26–11.76]; $P < 0.001$), and negatively associated with being diagnosed through mass screening (16.9% vs. 40.5%, OR = 0.20 [0.08–0.53]; $P = 0.001$) and receiving HCQ-AZM treatment for at least three days (OR = 0.37 [0.17–0.86]; $P = 0.02$).

4. Discussion

The first case of COVID-19 in the general population of Marseille was diagnosed on 03 March 2020. The epidemic peaked during the first week of April and remained active until the end of the month. This survey of LTCFs began when the entire French population was placed under strict lockdown (17 March 2020) and when the epidemic was active in Marseille. All LTCFs became confined environments with very strict restrictions being placed upon visits. A 13.4% SARS-CoV-2 positivity rate was found among dependant elderly residents in Marseille, which was significantly higher than the 5.4% positivity rate among all French dependant elderly

Table 4
Associations between multiple factors and SARS-CoV-2 deaths among 226 infected elderly residents (univariate and multivariate analysis).

Characteristics		Deaths N = 47	Survivors N = 179	Univariate OR [95% CI]	*P*-value	Multivariate aOR [95% CI]	*P*-value
Demographic factors (226) [1]							
Gender	Female, n (%)	19 (14.0)	116 (86.0)	Ref		Ref	
	Male, n (%)	28 (30.7)	63 (69.2)	**2.71 [1.40–5.24]**	**0.003**	**3.95 [1.65–9.44]**	**0.002**
Age (years)[2]	50–85, n (%)	18 (15.6)	97 (84.4)	Ref		Ref	
	> 85, n (%)	29 (26.1)	82 (73.9)	**1.90 [0.99–3.67]**	**0.055**	**2.43 [1.04–5.69]**	**0.041**
Chronic conditions (159)							
Cardiovascular diseases	No, n (%)	21 (21.0)	79 (79.0)	Ref			
	Yes, n (%)	12 (20.3)	47 (79.7)	0.98 [0.43–2.12]	0.92		
Hypertension	No, n (%)	23 (24.0)	73 (76.0)	Ref			
	Yes, n (%)	10 (15.9)	53 (84.1)	0.59 [0.26–1.36]	0.22		
Dementia	No, n (%)	28 (24.8)	85 (75.2)	Ref			
	Yes, n (%)	5 (10.9)	41 (89.1)	**0.37[0.13–1.02]**	**0.057**		
Mental disorder	No, n (%)	25 (20.9)	95 (79.1)	Ref			
	Yes, n (%)	8 (20.5)	31 (79.5)	0.98 [0.40–2.39]	0.96		
Diabetes mellitus	No, n (%)	27 (20.2)	107 (79.8)	Ref			
	Yes, n (%)	6 (24.0)	19 (76.0)	1.25 [0.45–3.43]	0.66		
Chronic lung diseases	No, n (%)	26 (18.6)	114 (81.4)	Ref			
	Yes, n (%)	7 (36.9)	12 (63.1)	**2.55 [0.91–7.12]**	**0.073**		
Stroke	No, n (%)	31 (21.8)	11 (78.2)	Ref			
	Yes, n (%)	2 (11.7)	15 (88.3)	0.47 [0.1–2.20]	0.34		
Cancer	No, n (%)	28 (19.4)	116 (80.6)	Ref			
	Yes, n (%)	5 (33.3)	10 (66.7)	2.07 [0.65–6.54]	0.215		
Chronic neurological disorder	No, n (%)	30 (20.4)	117 (79.6)	Ref			
	Yes, n (%)	3 (25.0)	9 (75.0)	1.30 [0.33–5.10]	0.71		
Diagnostic and therapeutic management factors							
Circumstances of diagnosis (226)	Case-by-case testing in patients with COVID-19 symptoms, n (%)	15 (40.5)	22 (59.5)	Ref		Ref	
	Mass testing, n (%)	32 (16.9)	157 (83.1)	**0.30 [0.14–0.64]**	**0.002**	**0.20 [0.08–0.53]**	**0.001**
Facility management of patients (226)	In LTCFs only	12 (19.4)	50 (80.3)	Ref			
	Other	35 (21.3)	129 (78.7)	1.13 [0.54–2.35]	0.74		
HCQ-AZM treatment for at least 3 days (226)	No, n (%)	29 (26.4)	81 (73.6)	Ref		Ref	
	Yes, n (%)	18 (15.5)	98 (84.5)	**0.51 [0.26–0.99]**	**0.047**	**0.37 [0.17–0.86]**	**0.02**
Housing facility effect[3] (226)	> 75%	26 (22.6)	89 (77.4)	Ref			
	25–75%	11 (20.0)	44 (80.0)	0.85 [0.38–1.89]	0.7		
	< 25%	10 (17.9)	46 (82.1)	0.74 [0.33–1.67]	0.48		
Oxygen therapy (199)	No, n (%)	18 (12.9)	122 (87.1)	Ref		Ref	
	Yes, n (%)	23 (39.0)	36 (61.0)	**4.33 [2.1–8.89]**	**< 0.001**	**5.16 [2.26–11.76]**	**< 0.001**
Ceftriaxone or ertapenem therapy (199)	No, n (%)	26 (19.1)	110 (80.9)	Ref			
	Yes, n (%)	15 (23.8)	48 (76.2)	1.32 [0.64–2.71]	0.45		
Low-molecular-weight heparin therapy (199)	No, n (%)	36 (20.6)	139 (79.4)	Ref			
	Yes, n (%)	5 (20.8)	19 (79.2)	1.01 [0.35–2.90]	0.97		

Abbreviations: Ref, Reference; NA, Not applicable; OR, Odds-ratio; aOR, adjusted Odds-ratio; LTCFs, long-term care facilities; HCQ, hydroxychloroquine; AZM, azithromycin.
[1] Number of individuals for whom data were available.
[2] Median of the variable was used for analysis.
[3] According to prevalence of HCQ-AZM treatment for at least 3 days among infected residents in each housing facility, as seen in Table 2 Bold lines indicate the variables recruited in initial multivariate mode.

residents, according to a national survey (37 405 confirmed cases in an estimated 695 060 French dependant elderly residents, $P < 0.001$, 02 June update) [1,14]. The current study observed an overall 20.8% COVID-19 fatality rate among infected residents in Marseille, which was significantly lower than that in all French LTCFs or medical-social establishments (27.7% fatality rate, $P = 0.026$, 02 June update) [1].

The main drivers of mortality in Marseille residents were older age and being male, as already reported in many studies [15]. In addition, systematic screening by PCR was identified as an independent protective factor against death from COVID-19. A symptom-based diagnostic strategy is less effective in LTCFs, most likely because elderly residents with comorbidities such as chronic respiratory or cardiovascular diseases may be unable to accurately report new symptoms suggestive of COVID-infection or may present with atypical symptoms that challenge medical staff [16,17]. Furthermore, from experience, > 23% of SARS-CoV-2-infected residents had no symptoms at the time of sampling. A very high prevalence (ca. 80%) was observed in a cross-sectional study conducted on elderly residents living in 2074 Belgian LTCFs [18]. The current study showed that there was a significant difference in fatality between patients treated with standardised treatment and untreated patients, as already reported in a study conducted among elderly patients living in a Spanish public nursing home in the same period [19].

Treatment with HCQ alone was demonstrated to be associated with lower mortality in patients admitted with COVID-19 [20–23]. Another cohort study conducted among American patients with rheumatic conditions showed an association between long-term HCQ treatment and reduced COVID-19 fatality rate [24]. The potential mechanisms of HCQ in the decrease of mortality in COVID-19 might be its inhibitory effects upon the production of the pro-inflammatory cytokines interleukin (IL)-1-β, TNF-α and IL-6, and chemokines (CCL2 and CCL3) involved in the recruitment of pro-inflammatory cells in the lungs [25].

The current study had some limitations: the population was not randomly and homogenously recruited; data regarding demographics, chronic conditions and clinical status were not systematically documented; frailty, which has been shown to be a major risk factor for mortality in COVID-19, was not evaluated due to the retrospective design [26]; and the use of individual preventive measures was not documented.

Nevertheless, it is believed that even if there were biases, as in any comparative study including randomisation, these biases were relatively neutralised by the multifactorial study. Above all, it was demonstrated that the mortality in patients treated in LTCFs in Marseille was half that of those in nursing homes across France who, in most cases, very likely did not receive specific treatment, since its use is restricted to the hospital setting [27,28]. The current authors believe that it is important to focus on the population with the highest mortality, to show a significant effect, and agree in this sense with several studies that have shown a reduction in mortality of 30% to 50% by HCQ-AZM in populations most at risk [29,8].

Declarations

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