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# Clinical features and medical care factors associated with mortality in French nursing homes during the COVID-19 outbreak

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ABSTRACT

*Objectives:* This study aimed to identify demographic, clinical and medical care factors associated with mortality in three nursing homes in France.
*Methods:* Two nursing homes were hospital-dependent, had connections with infection prevention and control departments, and had permanent physicians. A third nursing home had no direct connection with a general hospital, no infection control practitioner, and no permanent physician. The main outcome was death.
*Results:* During the first 3 months of the outbreak, 224 of 375 (59.7%) residents were classified as COVID-19 cases and 57 of 375 (15.2%) died. The hospital-dependent nursing homes had lower COVID-19 case fatality rates in comparison with the non-hospital-dependent nursing home (15 [6.6%] vs 38 [25.8%], OR 0.20 [0.11–0.38], $p = 0.001$). During the first 3 weeks of the outbreak, mortality in COVID-19 patients decreased if they had a daily clinical examination (OR: 0.09 [0.03–0.35], $p = 0.01$), three vital signs measurement per day (OR: 0.06 [0.01–0.30], $p = 0.001$) and prophylactic anticoagulation (OR: 0 [0.00–0.24], $p = 0.001$).
*Conclusions:* This study suggested that high mortality rates in some nursing homes during the COVID-19 outbreak might have been contributed by a lack of medical care management. Increasing human and material resources, encouraging presence of nursing home physicians and establishing a connection with general hospitals should be considered to deal with present and future health disasters in nursing homes.


## Introduction

The Coronavirus disease 2019 (COVID-19) pandemic had caused 53 million confirmed cases and 1.3 million deaths worldwide by 15 November 2020; 1,918,345 cases and 43,913 deaths were reported in France (World Health Organization, 2020a). More specifically, 44% of COVID-19 deaths in France occurred in nursing homes, and the mean COVID-19 case fatality rate was 20% among these facilities (République Française: Ministère de la Santé et de la Solidarité, 2020). However, many outbreaks in nursing homes resulted in higher case fatality rates, sometimes up to 30% (McMichael et al., 2020). This underlines the urgent necessity to understand the medical care factors associated with mortality and to enforce preventive measures in these facilities (Tan and Seetharaman, 2020).

At the beginning of the pandemic, no validated COVID-19 treatment existed; therefore, the World Health Organization proposed standards of care for severe COVID-19 patients, including oxygen therapy if required, daily clinical examination for adaptive fluid management and regular monitoring of vital signs (Pascarella et al., 2020; World Health Organization, 2020b). Prophylactic anticoagulation was also necessary in the context of bed rest and prothrombotic infection (Bikdeli et al., 2020; Tang et al., 2020;

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Jacobs, 2003). The French government recommended an increase in human and material resources in nursing homes rather than transferring all COVID-19 residents into overcrowded acute care units (Anon, 2020). Therefore, a lot of physicians, nurses, personal protective equipment (PPE) and oxygen tanks were required in nursing homes to implement these standards of care.

This study aimed to identify demographic, clinical and medical care factors associated with mortality in nursing home residents.

## Methods

This study was conducted in three nursing homes in the Ile-de-France region of France. It was conducted according to the Declaration of Helsinki. Written and oral information was given to residents and legal representatives. No patient or legal representative expressed opposition for inclusion in the study. A declaration of this study was made to the National Health Data Institute in order to ensure the protection of the computer data that were used. According to current French legislation, approval by the local ethic committee was not required because non-interventional research was conducted, meaning that all administered procedures and drugs did not differ from daily clinical practice. Two nursing homes (Homes A and B) were hospital-dependent, had connections with infection prevention and control departments, and had permanent physicians. The third nursing home (Home C) had no direct connection with a general hospital, no infection control practitioner and no permanent physician. Clinical data were collected during the first 3 weeks of the epidemic. Outcomes were collected during the first 3 months of the epidemic. Day 0 corresponded to the first day of symptoms of the first confirmed case among residents in each nursing home. The time frames were: 18 March–08 April 2020 for Home A; 22 March–12 April 2020 for Home B; and 20 March–10 April 2020 for Home C.

Nurses from all the nursing homes had been trained to recognise COVID-19 symptoms and alert physicians immediately. Two groups were considered in 'COVID-19 cases': (i) 'confirmed COVID-19 cases' with positive SARS-Cov-2 polymerase chain reaction (PCR) test or positive SARS-Cov2 serology. For the 3-week analysis, confirmed cases only having a positive serology had at least one COVID-19 symptom during the first 3 weeks. And (ii) 'presumed COVID-19 cases' who had at least one COVID-19 symptom assessed by a physician and their nursing home presented at least three 'confirmed cases' in their population. Patients who had negative serology were not considered as presumed cases.

Nursing home data and prevalence of sick leave among healthcare personal were collected by interviews with administrators, directors and nursing home physicians. Residents' characteristics were retrospectively collected: age, gender, grade of autonomy, abnormal nutritional status (obesity or underweight), 2019–2020 seasonal flu vaccination, arterial hypertension, heart failure, atrial fibrillation, ischaemic heart disease, thromboembolic venous disease, chronic obstructive pulmonary disease, solid or haematological neoplasia, chronic kidney disease, and diabetes. The autonomy, gerontology, iso-resources group (autonomie, gerontologie groupe iso resources or AGGIR) panel was used to evaluate the residents' autonomy, as it is the scale used in France (Benaim et al., 2005). According to this panel, grade 1 is given to elderly patients who are confined to bed and require continuous surveillance, while grade 6 is given to patients with preserved autonomy. Chronic kidney disease was defined as an estimated glomerular filtration rate <60 mL/min in at least two blood samples at baseline (Stevens and Levin, 2013). Regarding nutritional status, residents with a body mass index (BMI) >30 or <21 were confirmed obese or malnourished. Malnutrition was diagnosed for albumin levels <30 g/L.

Medical care data were also retrospectively collected: presence of a daily clinical examination, administration of a new preventive anticoagulation, intravenous (IV) or subcutaneous (SC) fluid therapy, oxygen therapy, new antibiotics administration, and hospital transfer were recorded. The number of vital signs measurements per day was also collected. Vital signs measurements included at least saturation of peripheral oxygen ($SpO_2$) and temperature. Residents receiving COVID-19 standards of care were defined as residents having a daily clinical examination, a new prescription of preventive anticoagulation therapy and vital signs measurements at least three times a day. COVID-19 symptoms were collected by physicians and nurses in specific files in order to identify COVID-19 cases.

The following analyses were performed: (i) description of the outbreak during the first 3 months; (ii) description of nursing home medical care management during the first 3 weeks; (iii) medical care characteristic comparison between high COVID-19 case fatality rate homes and low case fatality rate homes during the first 3 weeks; and (iv) analysis of demographic, clinical and medical care characteristics associated with death during the first 3 weeks in COVID-19 residents.

The main outcome was 3-week mortality in COVID-19 cases. Secondary outcomes were 3-week COVID-19 cases, 3-week confirmed COVID-19 cases in residents, sick leave for healthcare personnel, 3-month mortality, 3-month COVID-19 cases, and 3-month confirmed COVID-19 cases.

The following statistical tests were performed: Fisher test for qualitative variables and Wilcoxon Mann–Whitney U test for

**Table 1**
Infection control and medical care organisation during the first 3 weeks of the outbreak.

| Characteristics | Home A (n = 66) | Home B (n = 162) | Home C (n = 147) |
|---|---|---|---|
| Hospital-dependent home[a] | + | + | – |
| Permanent physician | 1 | 2 | 0 |
| Infection control practitioner[b] | + | + | – |
| Conforming surface detergent[c] | + | + | – |
| Isolation unit[d] | – | + | – |
| Isolation in room | + | + | + |
| Adequate PPE stock | + | + | – |
| Adequate oxygen tank stock | + | + | – |
| Nurse reinforcement | 2 | 0 | 0 |
| 24-h nurses | – | + | – |
| Replacement if sick leave | + | + | – |

PPE, personal protective equipment.
[a] Nursing home located nearby and being part of general hospital group.
[b] Intervention by infection control practitioner during COVID-19 outbreak.
[c] If detergent was conforming to the EN 14,476 European legislation.
[d] If a specific COVID-19 area was created in the nursing home.

quantitative variables. Quantitative variables were presented in the text as median values. Epi-info software (https://www.cdc.gov/epiinfo/index.html) was used to perform univariate analysis. To explore the risk factors associated with death, a multivariate logistic regression model was used. Considering the total number of deaths in this study and to avoid overfitting in the model, three variables were chosen based on previous findings (Zhou et al., 2020): age, peripheral oxygen saturation and daily clinical examination. Multivariate analysis was performed with SPSS software (https://www.ibm.com/analytics/spss-statistics-software). A two-sided $\alpha$ of <0.050 was considered to be statistically significant.

## Results

During the first 3 months of the outbreak, 188 of 375 (50.1%) residents were classified as confirmed COVID-19 cases. Overall, 57 of 375 (15.2%) residents died from all-causes. Four of 375 (1.1%) residents died without any COVID-19 symptoms. Due to a lack of reagent in France during the first 3 weeks of the study, 31 of 53 (58.5%) deceased residents had COVID-19 symptoms but did not have a SARS-Cov2 PCR and died before having the serology; they were classified as presumed COVID-19 cases.

The infection control policy and medical care organisation in each nursing home are presented in Table 1. Hospital-dependent nursing homes (Homes A and B) had a daily presence of a nursing home physician trained in geriatrics. Hospital infection control practitioners audited those two nursing homes at the onset of the pandemic to train healthcare personnel and ensure good infection control policy. Hospital-dependent nursing homes had expandable healthcare personnel capacity, oxygen tanks and PPE stock. Nursing Home C did not have a permanent nursing home physician. In case of a sick resident, a general practitioner located nearby visited the patient. Figure 1 shows lower COVID-19 case fatality rates in Home A and Home B than in Home C: 3 of 35 [8.6%] in Home A vs 12 of 59 [20.3%] in Home B vs 40 of 92 [42.5%] in

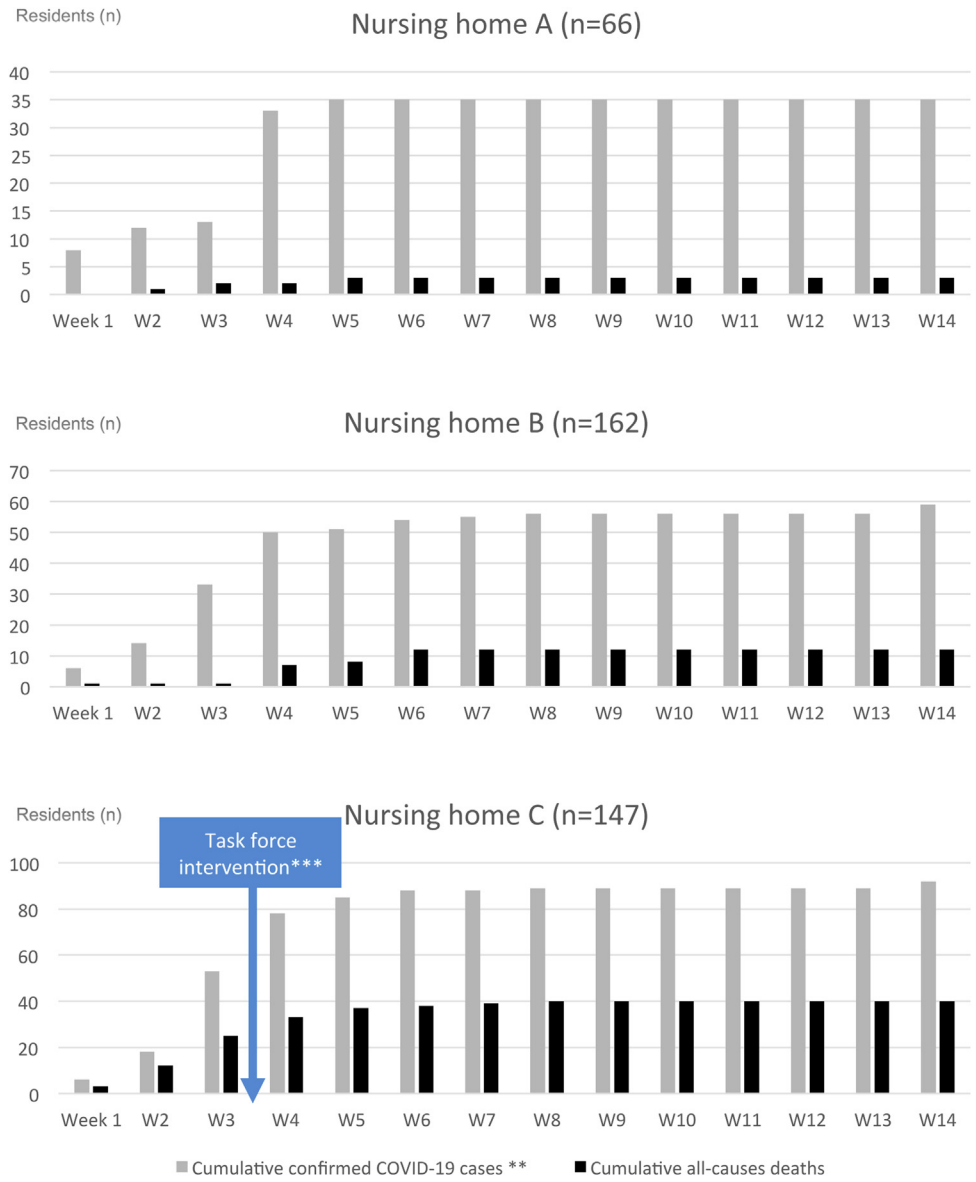


**Figure 1.** Epidemiology in nursing homes during first 3 months of the outbreak.*.
*Onset of local epidemic (J0) defined as the day where the first confirmed COVID-19 case had his first symptom.
**Confirmed COVID-19 cases if residents had positive SARS-Cov2 PCR or if residents had positive SARS-Cov2 serology.
***Task force intervention took action from 09 to11 April 2020.

Home C. Due to high mortality rates and lack of human and material resources, a task force intervention took action from 09 to 11 April to implement COVID-19 standards of care in Home C. The task force comprised specialists (infectious diseases, hygiene and geriatrics) from the county general hospital.

The hospital-dependent homes had fewer confirmed COVID-19 cases (92 of 228 [40.3%] vs 92 of 147 [62.6%]; $p = 0.001$) and deaths (16 of 228 [7.0%] vs 41 of 147 [27.9%]; $p = 0.001$), in comparison with hospital-dependent nursing homes, as shown in Table 2. Hospital-dependent nursing homes had lower COVID-19 case fatality rates in comparison with non-hospital-dependent nursing home (15 of 228 [6.6%] vs 38 of 147 [25.0%], OR 0.20 [0.11–0.38], $p = 0.001$). Hospital-dependent homes had more residents receiving COVID-19 standards of care during the first 3 weeks than Home C (27 of 228: [11.8%] vs 3 of 147: [2.0%]; $p = 0.001$).

No demographic characteristics and comorbidities were associated with mortality among COVID-19 residents (Table 3). The mean time between symptom onset and death was 8.0 days (IQR: 4.5–11.0). Deceased residents had fewer COVID-19 standard of care implementations than living residents (0 of 28: 0.0% vs 25 of 95: 26.3%; $p = 0.002$). It was observed that 16 of 28 (55.2%) deceased residents had $SpO_2 < 92\%$; eight of 28 (28.6%) received oxygen therapy. During the first 3 weeks, among presumed and confirmed COVID-19 deceased patients, 12 of 28 (42.6%) had $SpO_2 > 92\%$; all of these patients were in Home C and four of them were confirmed COVID-19 patients. In this population, symptoms were fever (eight of 12, [66%]), diarrhoea (three of 12, [25%]), asthenia (three of 12, [25%]) and cough (one of 12, [8%]). Multivariate analysis revealed that mortality was independently associated with daily clinical examination (aOR: 0.09 [0.03–0.35], $p = 0.001$) and $SpO_2 < 92\%$ (aOR: 4.06 [1.51–10.95], $p = 0.006$) (Table 4).

## Discussion

This study showed that deaths occurred more frequently in the nursing home with no effective infection control policy and lower medical care implementation. Death was not associated with demographic characteristics and comorbidities, but with fewer clinical examinations leading to less medical care. Most deaths were recorded in the non-hospital-dependent home (Home C), where residents received fewer clinical examinations, and less anticoagulation, fluid therapy, vital sign monitoring and antibiotics. Therefore, residents were more exposed to thromboembolism, hypovolaemic shock, hypoxia and bacterial superinfection. In this nursing home, 30.8% of deceased residents had not received oxygen therapy while they had $SpO_2 < 92\%$; it can be assumed that this was due to limited oxygen tank stock and absence of a permanent physician who could have either demanded oxygen tank supply or transferred the patient to hospital. Moreover, this nursing home had a higher infection rate in residents and multiple sick leave in healthcare personnel, which may have been the result of an unscrupulous infection control policy, mainly due to a shortage in PPE and inappropriate surface cleaning. This increase in sick leave might have resulted to inadequate hydration, nutrition and less vital signs monitoring for residents. These deficiencies in medical care and infection control management could easily be avoided in hospital-dependent nursing homes due to expandable medical and material resources. It is interesting to note that these differences in mortality did not occur the previous year, in a normal health context.

Research on the causes of death among COVID-19 patients has focused on comorbidities and direct effects of SARS-Cov2 infection (Hanley et al., 2020; Wang et al., 2020; Graham et al., 2020). However, during the first 3 weeks of the outbreak, among presumed and confirmed COVID-19 deceased patients, 12 of 28 (42.6%) had $SpO_2 > 92\%$, which might suggest that mortality is not always due to severe acute respiratory syndrome. All of these patients were in Home C and therefore had less medical care. Reasons for death in these patients are unknown due to the absence of medical investigations. A hypothesis would be that these deaths may have been the consequence of the 'confinement disease' defined as all adverse events linked to bed confinement and lack of medical care in confined elderly people (Diamantis et al., 2020). It means increased thrombosis, dehydration, depression, comorbidity decompensations, and unknown organ dysfunction. Increased thrombosis is due to bed rest and

**Table 2**
Outcome, clinical and medical care residents' characteristics of hospital-dependent (Homes A and B) and non-hospital-dependent nursing homes (Home C) (n = 375).

| Characteristics | Hospital dependent (n = 228) | Non-hospital dependent (n = 147) | OR (95% CI) | *p* |
|---|---|---|---|---|
| First 3-month outcomes[a] | | | | |
| All-cause death [n (%)] | 16 (7.0) | 41 (28.1) | 0.19 (0.10–0.36) | 0.001 |
| All-cause death for the same time frame one year before [n (%)] | 11 (4.8) | 6 (4.1) | 1.18 (0.42–1.27) | 0.74 |
| Death in COVID-19 presumed and confirmed cases [n (%)] | 15 (6.6) | 38 (25.8) | 0.20 (0.11–0.38) | 0.001 |
| Death in COVID-19 confirmed cases [n (%)] | 11 (4.8) | 11 (7.5) | 0.62 (0.26–1.48) | 0.28 |
| Confirmed COVID-19 cases[b] [n (%)] | 96 (42.1) | 92 (63.0) | 0.43 (0.28–0.65) | 0.001 |
| Presumed COVID-19 cases[c] [n (%)] | 9 (4.0) | 27 (18.5) | 0.17 (0.08–0.38) | 0.001 |
| First 3-week medical care management[d] | | | | |
| Daily clinical examination[e] [n (%)] | 107 (46.9) | 7 (4.8) | 17.69 (7.93–39.46) | 0.001 |
| TID vital signs measurements[f] [n (%)] | 64 (28.1) | 3 (2.0) | 18.63 (5.76–60.92) | 0.001 |
| Prophylactic anticoagulation[g] [n (%)] | 28 (12.3) | 12 (8.2) | 1.57 (0.78–3.31) | 0.21 |
| COVID-19 SOC[h] [n (%)] | 27 (11.8) | 3 (2.0) | 6.45 (1.92–21.66) | 0.001 |
| IV or SC fluid therapy [n (%)] | 30 (13.2) | 12 (8.2) | 1.70 (0.84–3.45) | 0.09 |
| Oxygen therapy [n (%)] | 19 (8.3) | 14 (9.5) | 0.86 (0.42–1.82) | 0.41 |
| Antibiotic [n (%)] | 24 (10.5) | 10 (6.8) | 1.61 (0.75–3.48) | 0.15 |
| Hospital transfer [n (%)] | 0 (0) | 6 (4.1) | 0.00 (0.00–0.41) | 0.003 |
| Sick leave [n (%)] | 27 (11.8) | 34 (23.1) | 0.45 (0.26–0.78) | 0.004 |

COVID-19 SOC, COVID-19 Standard of care; TID, ter in die or three times a day; IV, intravenous; SC, subcutaneous.
[a] First 3 months after the first confirmed COVID-19 case in each nursing home.
[b] Residents with positive SARS-Cov2 PCR or if residents had positive SARS-Cov serology.
[c] Residents with at least one COVID-19 symptom and at least three 'confirmed cases' were diagnosed in the facility.
[d] First 3 weeks after the first confirmed COVID-19 case in each nursing home.
[e] Daily clinical examination by a physician.
[f] Three vital signs measurement a day. Vital signs measurements included blood pressure, pulse, oximetry, respiratory rate and temperature.
[g] Only new prescription of preventive anticoagulation.
[h] COVID-19 Standards of care included preventive anticoagulation, fluid therapy if clinical dehydration and vital signs measurements three times a day.

**Table 3**
Demographic, clinical and medical care characteristics among dead or alive presumed and confirmed COVID-19 residents during the first 3 weeks of the outbreak (univariate analysis).

| Characteristics | Dead (n = 28) | Alive (n = 95) | OR (95% CI) | *p* |
|---|---|---|---|---|
| COVID-19 status | | | | |
| Confirmed COVID-19 cases[a] [n (%)] | 7 (25.0) | 95 (100) | – | 0.001 |
| Presumed COVID-19 cases[b] [n (%)] | 21 (75.0) | 0 (0) | – | 0.001 |
| Demographical parameters | | | | |
| Age [median (IQR)] | 86.5 (77–92) | 87.0 (81–93) | – | 0.27 |
| Female gender [n (%)] | 18 (64.3) | 75 (78.9) | 0.48 (0.19–1.20) | 0.11 |
| Grade of autonomy | | | | |
| AGGIR [median (IQR)] | 2.0 (1.0–3.0) | 2,1 (2.0–3.0) | – | 0.54 |
| Nutritional status | | | | |
| Obesity[c] [n (%)] | 2 (7.1) | 9 (9.5) | 0.73 (0.14–3.62) | 0.70 |
| Malnutrition[d] [n (%)] | 5 (17.9) | 21 (22.1) | 0.77 (0.26–2.26) | 0.62 |
| Vaccinations | | | | |
| Flu vaccination [n (%)] | 22 (78.6) | 83 (87.4) | 0.53 (0.18–1.57) | 0.25 |
| Co-morbidities | | | | |
| Arterial hypertension [n (%)] | 15 (53.6) | 57 (60.0) | 0.77 (0.33–1.80) | 0.54 |
| Heart failure [n (%)] | 4 (14.3) | 14 (14.7) | 0.96 (0.29–3.20) | 0.95 |
| Atrial fibrillation [n (%)] | 5 (17.9) | 22 (23.1) | 0.72 (0.25–2.12) | 0.55 |
| Ischaemic heart disease [n (%)] | 2 (7.1) | 9 (9.5) | 0.73 (0.15–3.61) | 0.70 |
| Thromboembolism[e] [n (%)] | 3 (10.7) | 13 (13.7) | 0.76 (0.20–2.87) | 0.68 |
| COPD [n (%)] | 3 (10.7) | 7 (7.4) | 1.51 (0.36–6.26) | 0.56 |
| Active cancer[f] [n (%)] | 0 (0) | 5 (5.3) | 0 (0.00–2.78) | 0.21 |
| Chronic kidney disease [n (%)] | 4 (14.3) | 17 (17.9) | 0.76 (0.23–2.49) | 0.65 |
| Diabetes [n (%)] | 11 (26.8) | 24 (25.3) | 1.91 (0.78–4.65) | 0.15 |
| Co-medications | | | | |
| Loop diuretics [n (%)] | 3 (10.7) | 18 (18.9) | 0.51 (0.14–1.89) | 0.31 |
| Thiazide diuretics [n (%)] | 0 (0) | 9 (9.5) | 0 (0.00–1.29) | 0.09 |
| α-Blockers [n (%)] | 1 (3.6) | 7 (7.4) | 0.59 (0.07–4.98) | 0.52 |
| Calcium channel blockers [n (%)] | 7 (25.0) | 24 (25.4) | 0.99 (0.37–2.60) | 0.98 |
| ACE inhibitors or ARB [n (%)] | 6 (21.4) | 20 (21.2) | 1.02 (0.37–2.82) | 0.97 |
| Beta-blockers [n (%)] | 8 (28.6) | 21 (22.1) | 1.40 (0.64–3.65) | 0.48 |
| Insulin [n (%)] | 1 (3.6) | 12 (12.6) | 0.25 (0.03–2.06) | 0.17 |
| Metformin [n (%)] | 3 (10.7) | 5 (5.3) | 2.16 (0.48–9.66) | 0.30 |

| Characteristics | Dead (n = 28) | Alive (n = 95) | OR (95% CI) | *p* |
|---|---|---|---|---|
| Symptoms | | | | |
| $SpO_2$ < 92% [n (%)] | 16 (55.2) | 21 (22.1) | 4.69 (1.93–11.46) | 0.001 |
| Diarrhoea [n (%)] | 7 (25.0) | 21 (22.1) | 1.17 (0.42–3.13) | 0.74 |
| Fever[g] [n (%)] | 18 (64.3) | 65 (68.5) | 0.83 (0.34–2.01) | 0.68 |
| Asthenia [n (%)] | 6 (21.4) | 31 (32.3) | 0.56 (0.20–1.60) | 0.26 |
| Cough [n (%)] | 10 (35.7) | 25 (26.3) | 1.56 (0.63–3.82) | 0.33 |
| Rhinorrhoea [n (%)] | 1 (3.6) | 3 (3.2) | 1.14 (0.11–11.4) | 0.91 |
| Conjunctivitis [n (%)] | 0 (0) | 4 (4.2) | 0 (0.00–5.19) | 0.27 |
| Fall [n (%)] | 0 (0) | 11 (11.6) | 0 (0.00–1.00) | 0.06 |
| Confusion [n (%)] | 0 (0) | 7 (7.4) | 0 (0.00–1.78) | 0.14 |
| Medical care management | | | | |
| Hospital-dependent NH resident [n (%)] | 3 (10.7) | 49 (51.6) | 8.88 (2.51–31.40) | 0.001 |
| Daily clinical examination[h] [n (%)] | 3 (10.7) | 55 (57.9) | 0.08 (0.02–0.31) | 0.001 |
| TID vital signs measurements[i] [n (%)] | 3 (10.7) | 51 (53.7) | 0.06 (0.01–0.30) | 0.001 |
| Prophylactic anticoagulation[j] [n (%)] | 0 (0) | 32 (33.7) | 0 (0.00–0.24) | 0.001 |
| COVID-19 SOC[k] [n (%)] | 0 (0) | 25 (26.3) | 0 (0.00–0.43) | 0.002 |
| IV or SC fluid therapy [n (%)] | 7 (25.0) | 26 (27.4) | 0.88 (0.33–2.32) | 0.80 |
| Oxygen therapy [n (%)] | 8 (28.6) | 18 (18.9) | 1.71 (0.65–4.50) | 0.27 |
| Antibiotic [n (%)] | 4 (14.3) | 23 (24.2) | 0.52 (0.16–1.66) | 0.26 |
| Hospital transfer [n (%)] | 4 (14.3) | 2 (2.1) | 7.75 (1.33–44.85) | 0.008 |

ACE, angiotensin converting enzyme; AGGIR, autonomy, gerontology, iso-resources group (autonomies, gerontology groupe iso resources); ARB, angiotensin II receptor blockers; CMD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; IV, intravenous; COVID-19 SOC, COVID-19 Standards of care; SC, subcutaneous; SpO2, peripheral oxygen saturation; TVP, thromboembolic venous disease; TID, ter in die or three times a day.

[a] Confirmed COVID-19 cases if residents had positive SARS-Cov2 PCR or if residents had symptoms and positive SARS-Cov2 serology.

[b] Presumed COVID-19 cases if residents had at least one COVID-19 symptom and at least three 'confirmed cases' were diagnosed in the facility.

[c] Defined as body mass index >30.

[d] Defined as body mass index <21 or albumin level <35 g/L.

[e] History of pulmonary embolism or venous thrombosis.

[f] Including both solid and haematological malignancies.

[g] Fever if temperature was >38.3 °C.

[h] Daily clinical examination by a physician.

[i] Three vital signs measurement a day. Vital signs measurements included blood pressure, pulse, oximetry, respiratory rate and temperature.

[j] Only new prescription of preventive anticoagulation.

[k] COVID-19 Standards of care included preventive anticoagulation, fluid therapy if clinical dehydration and vitals measurements three times a day.

**Table 4**
Demographic, clinical and medical care characteristics among dead or alive presumed and confirmed COVID-19 residents during the first 3 weeks of the outbreak (multivariate analysis).

| Characteristics | Dead (n = 28) | Alive (n = 95) | Multivariate OR (95% confidence interval) | *p* |
|---|---|---|---|---|
| Age <85[a] [n (%)] | 13 (46.4) | 31 (32.6) | 1.76 (0.64–4.82) | 0.27 |
| $SpO_2$ < 92% [n (%)] | 16 (55.2) | 21 (22.1) | 4.06 (1.51–10.95) | 0.006 |
| Daily clinical examination [n (%)] | 3 (10.7) | 55 (57.9) | 0.09 (0.03–0.35) | 0.001 |

[a] Residents strictly <85 years old.

pro-thrombotic infection (Bikdeli et al., 2020; Tang et al., 2020; Jacobs, 2003). Increased dehydration is due to symptoms like fever, tachypnoea and diarrhoea, but it might also be caused by a change in drinking behaviour due to social isolation and lack of care (Bunn et al., 2015; Hooper et al., 2014). Depression and comorbidity decompensation are due to social isolation, which lead to cachexia and failure to thrive (Simard and Volicer, 2020; Gerst-Emerson and Jayawardhana, 2015; Santini et al., 2020; Palmer, 1990). Unknown organ dysfunction is caused by less vital signs and biological monitoring. 'Confinement disease' can be fatal but could be limited with high standards of care.

Hospital transfers are traumatic for nursing home residents and hospital avoidance programs have been proven to be effective (Campbell et al., 2004; Kane et al., 2017; Christy and Molinari, 2011; Daras et al., 2017; Ouslander et al., 2014; Stall et al., 2020). All nursing homes should have an emergency management plan to enhance their infection control and medical response in the event of a local COVID-19 outbreak (Katz et al., 2009). It should include an infection control policy, permanent physician who implements the standards of care guidelines and reinforcement of material and medical resources, with a replacement policy for sick healthcare professionals (Katz et al., 2011; Schols et al., 2004). If this policy is implemented, managing COVID-19 cases in nursing homes might be a safe option.

This study had several limitations: (i) it was retrospective and included populations from only three nursing homes; (ii) the risk factors for mortality were analysed with a study period of 21 days and the results need to be confirmed over a longer period of time; and (iii) molecular diagnosis was not available for all deceased patients. However, it is well established that the COVID-19 epidemic was ongoing in the three nursing homes during the study period, as confirmed by the extremely high number of SARS-Cov2 positive patients. Confusing it with flu was unlikely because the influenza season had passed in the Ile-de-France region before the onset of the study (Grippe, 2020). Also, SARS-Cov2 PCR has a high false negative rate, even though it is currently considered the gold standard for diagnosing SARS-Cov2 infection (Jha, 2020). And (iv) causes of death remained unclear in presumed and confirmed COVID-19 patients without acute respiratory syndrome and further studies are needed to confirm the hypothesis of 'confinement disease'.

In conclusion, this study suggests that high mortality rates in some nursing homes during the COVID-19 outbreak might be contributed to by a lack of infection control and medical care management. Death may not always be caused by severe acute respiratory syndrome but also by 'confinement disease'. Increasing human and material resources, encouraging the presence of permanent physicians and establishing connections with general hospitals should be considered to deal with present and future health disasters in nursing homes.

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## Conflict of interests

The authors declare that they have no competing interests.

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