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COVID-19 infection and 2-year mortality in nursing home residents who survived the first wave of the pandemic

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Abstract

Background During the first COVID-19 pandemic wave (1st CoPW), nursing homes (NHs) experienced a high rate of COVID-19 infection and death. Residents who survived the COVID-19 infection may have become frailer. This study aimed to determine the predictive value of having a COVID-19 infection during the 1st CoPW for 2-year mortality in NH residents.

Methods This was a retrospective study conducted in three NHs. Residents who had survived the 1st CoPW (March to May 2020) were included. The diagnosis of COVID-19 was based on the results of a positive reverse transcriptase-polymerase chain reaction test. The collected data also included age, sex, length of residence in the NH, disability status, legal guardianship status, nutritional status, need for texture-modified food, hospitalization or Emergency Department visits during lockdown and SARS-COV2 vaccination status during the follow-up. Non-adjusted and adjusted Cox models were used to analyse factors associated with 2-year post-1st CoPW mortality.

Results Among the 315 CoPW1 survivors (72% female, mean age 88 years, 48% with severe disability), 35% presented with COVID-19. Having a history of COVID-19 was not associated with 2-year mortality: hazard ratio (HR) [95% confidence interval] = 0.96 [0.81–1.13], $p = 0.62$. The factors independently associated with 2-year mortality were older age (for each additional year, HR = 1.05 [1.03–1.08], $p < 0.01$), severe disability vs. moderate or no disability (HR = 1.35 [1.12–1.63], $p < 0.01$) and severe malnutrition vs. no malnutrition (HR = 1.29 [1.04–1.60], $p = 0.02$). Considering that vaccination campaign started during the follow-up, mortality was associated with severe malnutrition before and severe disability after the start of the campaign. Vaccination was independently associated with better survival (HR 0.71 [0.55–0.93], $p = 0.02$).

Conclusions Having survived a COVID-19 infection during the 1st CoPW did not affect subsequent 2-year survival in older adults living in NHs. Severe malnutrition and disability remained strong predictor of mortality in this population, whereas vaccination was associated to better survival.

Keywords COVID-19, Long-term mortality, Nursing homes, Older adults

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Background

Nursing home (NH) residents were seriously affected by the first COVID-19 pandemic wave (1st CoPW) [1–3]. The older population is at risk for severe clinical forms of COVID-19 and increased mortality [4]. Survivors are likely to experience a decline in their health status. Among NH survivors of the 1st CoPW, COVID-positive residents had a 4-fold greater chance of developing frailty [5] and lost weight more often [6] than COVID-negative residents. NH survivors of COVID-19 had not recovered baseline ADL functioning at 3-month follow-up [6]. Likewise, in hospitalised older patients with COVID-19, 3 month-follow-up showed functional decline and worsening frailty status compared to their preadmission status [7], and similar findings were reported in COVID-19 patients in intensive care wards [8, 9].

Post-COVID-19 functional decline, frailty and malnutrition can be expected to impact subsequent mortality. However, in NH, long-term mortality in COVID-19 survivors has received little attention. To the best of our knowledge, in NH, only one study compared mortality between COVID-positive and COVID-negative survivors of the 1st CoPW: 6-month mortality did not differ between groups [10]. These results need to be confirmed as a better understanding of the prognostic value of a history of COVID-19 would allow to adapt care plans in this specific population.

The main objective of this study was to determine the impact of having survived a COVID-19 infection during the 1st CoPW in NH, as opposed to having survived the 1st CoPW without contracting a COVID-19 infection, on 2-year mortality. The secondary objective was to identify other risk factors associated with 2-year mortality.

Table 1 Characteristics of first COVID-19 pandemic wave surviving residents and 2-year mortality

	MD	Total Population *N* = 315	2-year mortality		
			Yes *N* = 145	No *N* = 170	*P*
Before 1stCoPW					
Female sex		226 (72)	102 (70)	124 (73)	0.61
Age (years)		88 ± 8	90 ± 8	86 ± 8	< 0.01
Length of stay in the NH (months)		55 ± 32	54 ± 32	56 ± 31	0.50
Disability	2				
Moderate-none		164 (52)	55 (38)	109 (65)	< 0.01
Severe		149 (48)	89 (62)	60 (35)	
Legal guardianship	12	115 (38)	56 (42)	59 (35)	0.22
Texture-modified food	59	114 (45)	66 (60)	48 (33)	< 0.01
End of the 1stCoPW					
Malnutrition	5				
No		147 (47)	54 (38)	93 (56)	< 0.01
Moderate		75 (25)	32 (22)	43 (26)	
Severe		88 (28)	57 (40)	31 (18)	
COVID status					
COVID-negative		204 (65)	97 (67)	107 (63)	0.46
COVID-positive		111 (35)	48 (33)	63 (37)	
Hospitalization*					
Not related to COVID-19		27 (9)	10 (7)	17 (10)	0.33
Related to COVID-19		10 (3)	6 (4)	4 (2)	0.26

1stCoPW: first COVID-19 pandemic wave; MD: Missing data; NH: Nursing home. ED: Emergency Department. The results are expressed as the means ± SDs or counts (%). Student's t test and the chi-square test were used to compare the characteristics of the participants according to 2-year mortality. *Including Hospitalization and ED visit

Methods

Study design and ethics

We conducted a retrospective multicentre observational study with a 2-year survival analysis. This ancillary study included the participants of our previously published study that aimed to assess the impact of COVID-19 and lockdown sanitary restrictions on weight loss in NH residents [11]. Residents from 3 NHs were included at the end of the 1st CoPW in May 2020, after they received written information and were not opposed to participate in the study. Residents under guardianship were included on the condition that their guardian was informed and did not express opposition. The inclusion criteria were (I) being a resident of one of the three NHs during the first pandemic wave (from March 11th to May 11^{th,} 2020); (II) having survived to the 1st CoPW having contracted the COVID-19 or not; and (III) having information on nutritional status before and after the pandemic wave. Supplementary Table 1 shows the main characteristics of the three nursing homes at the time of the study. The study protocol was reviewed and approved by the *Gérontopôle d'Ile-de-France* Ethics Committee (approval number: 22,021), and registered in the Clinical Trial system (NCT06468761).

Data collection

The investigator collected the characteristics of the participants from the computerized database of each NH. Participants' medical records were unavailable because residents were cared for by their community general practitioners and the medical records were not saved in the NH databases. Due to the retrospective design of the study the number of variables that could be collected was limited. Thus the assessment of potential confounding factors such as comorbidities frailty medications or the severity of COVID-19 was not possible. COVID-19 status was determined using reverse transcription–polymerase chain reaction (RT–PCR). We also recorded age, sex, length of residence in the NH, being under legal guardianship (considered a proxy for severe cognitive or psychiatric disorders), malnutrition according to the Global Leadership Initiative on Malnutrition (GLIM) criteria [12], based on weight loss during the 1st

CoPW and BMI at the end of the lockdown (information regarding muscle mass was not available), texture-modified food (minced or pureed food, considered as a proxy of dysphagia) and impairment in activities of daily living using the *Groupe Iso Ressource* (GIR) score [13]. The GIR is a French administrative score system that assesses basic activities of daily living (walking, feeding, dressing, washing, and urinary and faecal continence) and more complex activities (perception of time and place, managing medication, shopping and finances and using a telephone). The GIR can vary from 1 (bed-ridden or major physical and mental limitations requiring assistance in all daily living activities) to 6 (no disability). We categorized participants who scored GIR 1 and 2 as severely disabled and participants who scored GIR≥3 as moderately disabled or having no disability. Disability status was not reassessed after the 1st CoPW. Hospital admissions and Emergency Department (ED) visits were collected by cross-referencing the NH database with the admission database of the referral hospitals. COVID-19-related hospital admissions or ED visits were identified. The vaccination campaign started 7 months after the end of the 1st CoPW during the 2-years follow-up. Information regarding vaccination (at least one dose) was recorded.

The 2-year mortality data collection started after the end of the 1st CoPW, from May 11th, 2020, to July 15th, 2022, when the NH database, the referral hospital records and the civil register were collected. The maximum follow-up time was 26 months.

Statistical analyses

Resident characteristics at the end of the lockdown were described by numbers (percentages, %) for categorical variables and means (standard deviations, SDs) for quantitative variables. The baseline characteristics were compared according to survival during the 2-year follow-up. After visual verification, because the sample size was greater than 30 individuals per group, we assumed that the distribution of continuous variables followed a normal distribution pattern. Continuous variables were compared using Student's t test. Categorical variables were compared using the chi-square test, Yates continuity correction test, or Fisher's exact test.

Kaplan Meier curves were generated to analyse survival during the 2-year follow-up stratified by COVID-19 status at the time of the 1st CoPW. The curves were compared by the log-rank or Wilcoxon test as appropriate. A Cox models were used to analyse the associations between variables and survival before and after adjustments. COVID-19 vaccination started in January 2021 in the NHs. We also performed two supplementary survival analyses: one during the period before (May 11th 2020 to January 31st 2021) and one after (February 1st 2021 to July 15th 2022) the start of vaccination campaign. The adjusted model included the variables associated with 2-year mortality in the unadjusted analysis ($p<0.20$) and less than 10% of the data were missing. The centre was added to the models. The results are presented as hazard ratios (HRs) with 95% confidence intervals (95% CIs). The level of statistical significance was defined as $p<0.05$. Analyses were performed using JMP 9.0.3 (SAS Software®).

Results

Among the 403 residents who lived in the three NHs when the 1st CoPW started, 59 (15%) died during the wave. Among survivors at the end of the 1st PW, 315 residents were included in the study (flow chart in Fig. 1). It corresponds to 78% of all the residents that were in the three NHs at the start of the 1st CoPW. Among included participants, 111 (35%) contracted COVID-19 and survived during the first wave of the pandemic. Ten (9%) COVID-positive participants were hospitalized due to COVID-19 symptoms. The median (Q1; Q3) follow-up was 24 (12; 25) months after the end of the lockdown. During this period, 145 (46%) residents died (mortality rate of 26 per 100 residents per year). The characteristics of the total population and according to the survival during the follow-up are summarized in Table 1. Compared to those who survived afterwards, the residents who died during the follow-up were significantly older, had greater disability according to the GIR, required more frequently texture-modified food, had a lower BMI and experienced significantly greater weight loss during the first PW, resulting in more prevalent severe malnutrition according to the GLIM criteria.

Figure 2 presents Kaplan–Meier curves for 2-year survival as a function of having a history of COVID-19 during the 1st CoPW1 or not. The associations with 2-year survival according to the non-adjusted and adjusted Cox models are presented in Table 2. A history of COVID-19 infection and survival during the 1st CoPW were not associated with excess 2-year mortality (HR [95% CI] 0.96 [0.80–1.13], $p=0.62$). Factors associated with 2-year mortality in the unadjusted Cox model were older age, severe disability, requiring texture-modified food and severe malnutrition after the lockdown. According to the adjusted Cox model (including age, disability, legal guardianship, malnutrition, hospitalization during the 1st CoPW and centre), older age (1.06 [1.03–1.09], $p<0.01$), severe disability (1.34 [1.11–1.63], $p<0.01$) and severe malnutrition (1.51 [1.14–1.97], $p=0.02$) were independently associated with poorer survival. A trend toward higher mortality was observed in the case of legal guardianship (1.20 [0.99–1.44], $p=0.07$). Some associations with mortality differed when considering the two distinct periods before (Table 3) and after (Table 4) the start of COVID-19 vaccination campaign in the NHs:

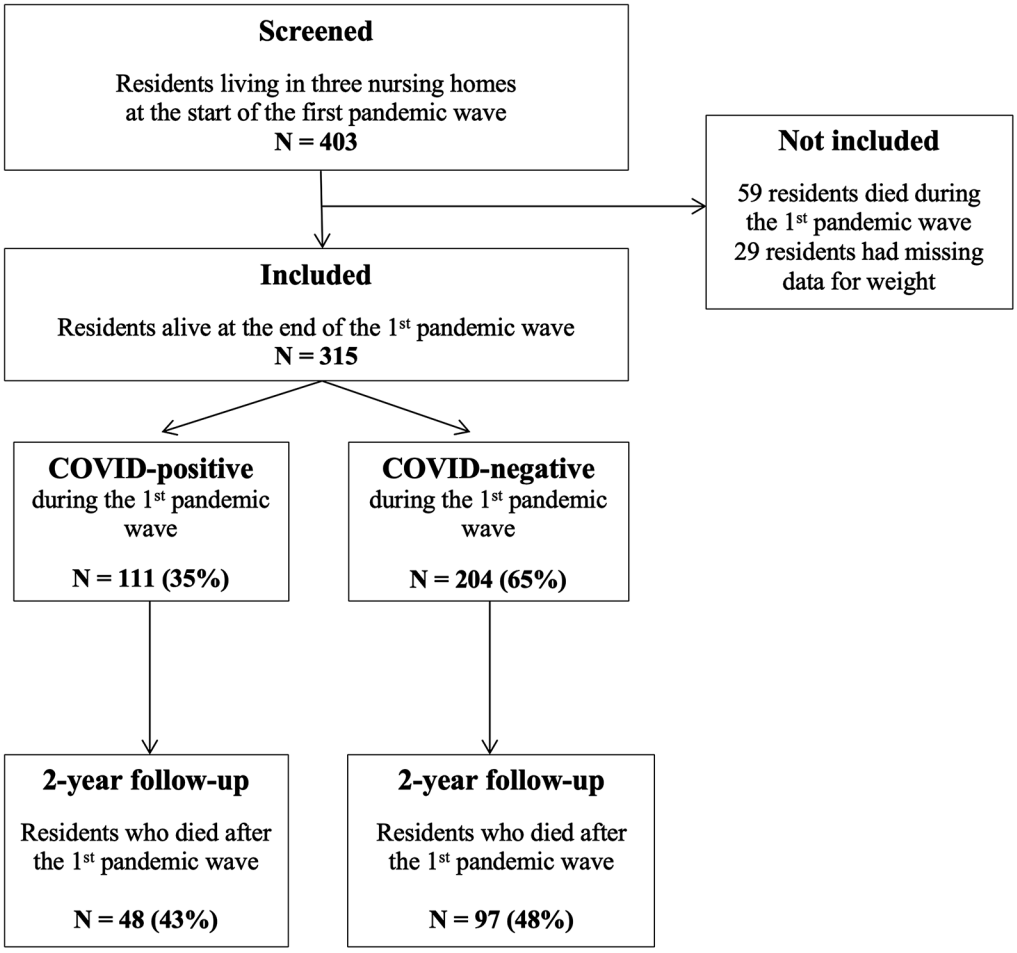

Fig. 1 Flow-chart

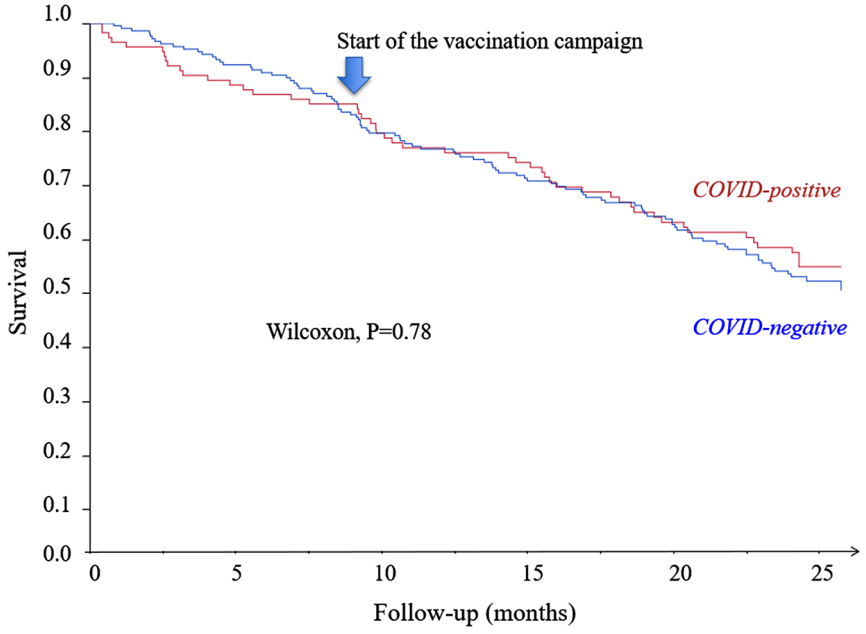

Fig. 2 Kaplan–Meier curves for survival during follow-up stratified by COVID–19 status during the first wave of the pandemic

Table 2 Associations between the characteristics of residents and 2-year mortality

	2-year mortality			
	Unadjusted HR (95% CI)	***P***	**Adjusted HR (95% CI)**	***P***
Female sex	0.93 (0.78–1.12)	0.46	-	
Age (years)	1.06 (1.03–1.08)	< 0.01	1.06 (1.03–1.09)	< 0.01
Length of stay in the nursing home (months)	1.00 (0.99–1.00)	0.37	-	
Severe disability (vs. moderate or no disability)	1.43 (1.21–1.70)	< 0.01	1.34 (1.11–1.63)	< 0.01
Legal guardianship	1.15 (0.96–1.36)	0.13	1.20 (0.99–1.44)	0.07
Texture-modified food (vs. normal)	1.48 (1.23–1.80)	< 0.01	-	
COVID-positive (vs. COVID-negative)	0.96 (0.81–1.13)	0.62	-	
Malnutrition				
Moderate malnutrition (vs. no malnutrition)	1.09 (0.87–1.36)	0.43	-	
Severe malnutrition (vs. no malnutrition)	1.59 (1.32–1.91)	< 0.01	1.51 (1.14–1.97)	0.02
Hospitalization* during the 1stCoPW (vs. absence of hospitalization)				
Hospitalization not related to COVID-19	1.44 (0.90–2.08)	0.11	1.01 (0.48–1.88)	0.56
Hospitalization related to COVID-19	1.16 (0.73–1.75)	0.50	-	
Any hospitalization	1.28 (0.92–1.68)	0.13	-	

Associations between the characteristics of residents and 2-year mortality were tested using Cox models. The adjusted Cox model included age, disability, legal guardianship, severe malnutrition, hospitalization and centre. The results are expressed as hazard ratios (HRs) and 95% confidence intervals (95% CIs). For the variables age and length of stay in the nursing home, the HR was calculated for a one-unit increase. *Combining Hospitalization and Emergency Department visits without hospitalization

Table 3 Associations between the characteristics of residents and mortality before the start of the vaccination campaign

	Mortality before vaccination campaign			
	Unadjusted HR (95% CI)	***P***	**Adjusted HR (95% CI)**	***P***
Female sex	0.99 (0.74–1.38)	0.97	-	
Age (years)	1.09 (1.04–1.14)	< 0.01	1.10 (1.04–1.15)	< 0.01
Length of stay in the nursing home (months)	1.00 (0.99–1.01)	0.80	-	
Severe disability (vs. moderate or no disability)	1.06 (0.80–1.41)	0.68	-	
Legal guardianship	1.22 (0.89–1.68)	0.21	-	
Texture-modified food (vs. normal)	1.49 (1.01–2.24)	0.04	-	
Malnutrition (vs. no malnutrition)				
Moderate malnutrition	1.09 (0.71–1.64)	0.68	-	
Severe malnutrition	1.75 (1.27–2.44)	< 0.01	2.13 (1.36–3.38)	< 0.01
Hospitalization* during the 1stCoPW (vs. absence of hospitalization)				
Hospitalization not related to COVID-19	1.60 (0.79–2.66)	0.17	1.42 (0.48 – 4.44)	0.79
Hospitalization related to COVID-19	0.81 (0,19 – 1.74)	0.66	-	
Any hospitalization	1.22 (0.67 – 1.92)	0.47	-	

Associations between the characteristics of residents and mortality during the period before the start of the vaccination campaign (May 11th 2020 to end of January 31st 2021) were tested using Cox models. The adjusted Cox model included age, severe malnutrition, hospitalization and centre. The results are expressed as hazard ratios (HRs) and 95% confidence intervals (95% CIs). For the variables age and length of stay in the nursing home, the HR was calculated for a one-unit increase. ED: Emergency Department

severe malnutrition remained independently associated with mortality before the vaccination campaign started whereas severe disability was associated with mortality after. Among people who survived until the start of the campaign, being vaccinated was associated with better survival.

Discussion

This study showed that in NH residents who had survived the 1st CoPW, having a history of COVID-19 during the 1st CoPW did not affect 2-year mortality. The independent risk factors for 2-year mortality were increasing age, severe disability and severe malnutrition.

We had hypothesized that COVID-positive residents would have a higher 2-year mortality than the COVID-negative residents because we had studied this population at the end of the 1st CoPW and showed that COVID-positive survivors had more often lost ≥ 5% of body weight during 1st CoPW than the COVID-negative survivors [11]. Also, because other studies had described a worsening in frailty and functional status in older COVID-19 survivors [5] and disability and malnutrition are risk factors for increased mortality [14–16]. The finding that having a history of COVID-19 had no impact on 2-year mortality in NH 1stCoPW survivors is intriguing, but is in line with the previously published results of 6-month mortality in NH COVID-positive survivors [10]. In that study, mortality was much higher in COVID-positive than in COVID-negative residents 30 days after PCR testing. Risk factors for 30-day mortality were fatigue and deoxygenation, suggesting more severe forms of COVID-19. However, among residents who survived a COVID-19 infection, the 6-month mortality risk was not sustained [10]. In our study, the severity of COVID-19 symptoms was not documented. We assume that by including only the survivors of the 1st CoPW (15% of residents died during the 1st CoPW in our study), we selected residents with less severe forms of COVID-19 infection. Hospitalizations and ED visits may reflect severity of the disease

Table 4 Associations between the characteristics of residents and mortality after the start of the vaccination campaign

	Mortality after vaccination campaign			
	Unadjusted HR (95% CI)	***P***	**Adjusted HR (95% CI)**	***P***
Female sex	0.90 (0.73–1.13)	0.37	-	
Age (years)	1.05 (1.02–1.08)	< 0.01	1.03 (1.00–1.06)	0.045
Length of stay in the nursing home (months)	1.00 (0.99–1.00)	0.18	-	
Severe disability (vs. moderate or no disability)	1.69 (1.37–2.11)	< 0.01	1.59 (1.28–2.00)	< 0.01
Legal guardianship	1.11 (0.90–1.37)	0.30	-	
Texture-modified food (vs. normal)	1.48 (1.19–1.85)	< 0.01	-	
Malnutrition (vs. no malnutrition)				
moderate malnutrition	1.13 (0.87–1.46)	0.35	-	
severe malnutrition	1.51 (1.19–1.90)	< 0.01	1.17 (0.90–1.52)	0.23
Hospitalization* during the 1stCoPW (vs. absence of hospitalization)			-	
Hospitalization not related to COVID-19	1.33 (0.66–2.17)	0.38	-	
Hospitalization related to COVID-19	1.30 (0.77–1.94)	0.29	-	
Any hospitalization	1.31 (0.87–1.82)	0.48	-	
Vaccination during follow-up (yes vs. no)	0.60 (0.48–0.76)	< 0.01	0.71 (0.55–0.93)	0.02

Associations between the characteristics of residents and mortality during the period after the start of the vaccination campaign (February 1st 2021 to July 15th 2022) were tested using Cox models. The adjusted Cox model included age, severe malnutrition and centre. The results are expressed as hazard ratios (HRs) and 95% confidence intervals (95% CIs). For the variables age and length of stay in the nursing home, the HR was calculated for a one-unit increase. ED: Emergency Department

and were recorded during the 1st CoPW. In COVID-positive survivors, hospitalizations and ED visits were not associated with an increase in 2-year mortality. Also, in our study, comorbidities were not documented. In hospitalized all-age COVID-19 patients, in-hospital mortality was strongly influenced by chronic diseases, which are also common in NH residents [17]. However, in geriatric acute care wards, the Charlson comorbidity index was not associated with COVID-19 in-hospital mortality [18]. In addition, the previously published study in NH [10], comorbidities were extensively described but were not associated with 30-day or 6-month mortality in COVID-positive residents [10]. Why having a history of COVID-19 is not associated with mortality in NH COVID-19 survivors remains to be explained. It may have to do with personal psychological and physical resilience, as defined by the ability to recover in the face of disease [19], leading to better recovery trajectories in COVID-19 survivors [6].

Interestingly, the survival curves were superposable and linear in COVID-positive and COVID-negative groups, suggesting that the four subsequent COVID-19 pandemic waves (observed in France as follows: the 2nd wave between August 1st, 2020, and December 31st, 2020; the 3rd wave between January 1st, 2021, and June 30th, 2021; the 4th wave between July 1st, 2021, and December 31st, 2021; and the 5th Omicron wave between January 1st and 31st, 2022) and the vaccination campaign (starting on December 27th, 2020, in French NH) had no impact on the mortality rate in either group over the 2-year follow-up. Likewise, epidemiology data from the UK and the USA showed a return to an average and stable rate of mortality in NH after the 1stCoPW mortality peak, as opposed to excess mortality rates at home and in medical facilities lasting up to 3 years after the 1st CoPW [20, 21]. Surviving COVID-19 infection in the 1st CoPW may have conferred some COVID-19 immunity during the second pandemic wave, even if immunity has been shown to altered in NH residents [22]. After the second pandemic wave, the vaccination campaign was thorough in French NH. We observed that being vaccinated was an independent protective factor for mortality.

The results of our study must be interpreted with regard to methodological limitations. First, this was an observational study that does not allow to draw conclusions on the causal relationships between the assumed risk factors and mortality. In particular, disability status was not re-assessed after the 1st CoPW, and we used the pre1st CoPW as a potential confounding factor for post-1st CoPW mortality. Second, its retrospective design limited the number of variables that could be collected, such as the severity of the COVID-19, comorbidities, polypharmacy, use of specific drugs in COVID-positive residents or the cause of death during the 2-year follow-up. During the 1stCoPW and lockdown, nursing homes were severely affected by COVID-19 as NH residents ultimately accounted for almost half of the 30, 000 COVID-19-related deaths during the first wave of the pandemic in France. Healthcare professional faced a health emergency with poor equipment and working conditions and suffered high levels of burnout and psychological exhaustion [23]. Geriatric assessment and screening for frailty was not a priority. Furthermore, medical records were mostly kept by private general practitioners outside the NH, not allowing to collect data retrospectively.

Conclusions

Our study showed that in NH residents who survived the1stCoPW, having a history of COVID-19 was not associated with subsequent 2-year excess mortality. Being vaccinated during the 2-year follow-up reduced significantly the subsequent risk of death. Other risk factors for mortality were age, disability ad malnutrition.

Healthcare professionals should consider these factors to propose specific and individualized interventions for NH residents.

Abbreviations

1st CoPW	First COVID-19 pandemic wave
BMI	Body mass index
GIR	*Groupe iso resource*
GLIM	Global leadership initiative on malnutrition
HR	Hazard ratio
NH	Nursing home
RT-PCR	Reverse-transcription polymerase chain reaction
SD	Standard deviation

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-024-05220-w.

Supplementary Material 1

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Author contributions
MS, PCA, VH and ARS designed the study. VH, HA and CC collected data in nursing homes. MS and PCA performed statistical analysis. MS, PCA, and ARS contributed in writing the manuscript. All authors read and approved the final manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study protocol was reviewed and approved by the *Gérontopôle d'Ile-de-France* Ethics Committee (approval number: 22021). In accordance with French ethical requirements for retrospective studies, each participant or legal guardian was informed of the study by mail and asked to consent to the use of the data within one month. In case of refusal to participate expressed by a phone call or a return mail, the participants were excluded from the study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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