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COVID-19 Incidence and Mortality in Patients Operated on for Breast Cancer. Comparison with the General Population

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Abstract

One thousand forty-three BC patients had a Covid test and made our study group, which was conveniently compared with the COVID-19 tested background feminine Catalan population. Covid-19 incidence and mortality were indeed higher among BC patients, although BC per se without metastases was not linked to increased mortality. Metastases and nurse home dwellings were significantly associated with mortality.

Background: Breast Cancer (BC) remains the most diagnosed malignancy and the most common cause of cancer-related mortality in women worldwide. Covid-19 mortality in BC patients has been linked to comorbid conditions rather than to cancer treatment itself, although this was not confirmed by a meta-analysis. Also, during Covid-19 outbreaks, a great deal of health care resources is reassigned to critical Covid-19 patients. Patients and Methods: During 5 consecutive trimesters (from 1/12/2020 to 31/3/2021) 2511 BC patients older than 20 years from our institution were surveyed. 1043 of them had received a Covid test and these made our study group, which was conveniently compared with the Covid-19 tested background feminine Catalan population. Results: 13.1% of our patients presented with a positive Covid-19 test, whereas confirmed COVID-19 infection amounted to 7.1% of the feminine Catalan tested population. The COVID-19-specific mortality rate was 11.7% (16/137) in the study group, which compares with a 4.7% rate for the overall population. Most deaths occurred in patients over 70. Conclusion: Three clinical factors were significantly associated with Covid-19 mortality in BC, namely lack of hormone therapy, distant metastases, and BC dwelling in nursing homes. BC patients are at a higher risk of Covid-19 infection and mortality in comparison with the reference group without BC.

Clinical Breast Cancer, Vol. 23, No. 2, 135–142 © 2022 Published by Elsevier Inc.

Keywords: Breast neoplasms, Comorbidity, Covid-19, Nursing homes, Survival

Background

Some reports in the literature initially suggested that, within the present Covid-19 pandemic crisis,1 patients with a history or with active malignant disease were at higher risk of getting infected, as well as of developing Covid-19-related complications.2,4 However, such reports were often limited by short sample size, or by being restricted to a specific geographical area, and therefore their findings could not be easily extrapolated to the general population of cancer patients.5 The notion that cancer patients are at a higher risk for Covid-19 has been further supported by additional research.5,9 On the other hand, it has been shown that cancer patients infected by the SARS-COV2 virus tend to develop an antibody response similar to that of previously healthy subjects.10

Breast Cancer (BC) is indeed both the most commonly diagnosed malignancy and the most common cause of cancer-related mortality in women worldwide.11 A fresh report suggested that Covid-19 mortality rates in BC patients were related to comorbid conditions, rather than to cancer treatment itself,12 although such results were not confirmed by a subsequent meta-analysis.13

Also, it is acknowledged that, during Covid-19 outbreaks, a great deal of healthcare resources is reassigned to critical Covid-19 patients.14

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Submitted: Jun 28, 2022; Revised: Nov 8, 2022; Accepted: Nov 11, 2022; Epub: 17 November 2022

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COVID-19 Incidence and Mortality in Patients Operated on for Breast Cancer

Singh MK et al\textsuperscript{15} were able to show that basal ACE2 receptor (angiotensin-converting enzyme type 2 receptor) cell expression was significantly increased in several conditions, including leukemia, lung, breast, or cervical cancer, as well as in non-alcoholic fatty liver, psoriasis, and hospital-acquired pneumonia. Increased cell ACE2 receptor expression may enhance viral cell invasion and thus, explain greater susceptibility for SARS-CoV-2 infection in patients with such conditions.

Furthermore, often patients with malignancies are older, mostly over 60, and sustain significant comorbidities, which in themselves lead to a greater risk of Covid-19-related morbidity and mortality.\textsuperscript{16} Increased Covid-19 mortality rates seem associated with factors such as disease severity, lack of specific treatment, and, perhaps strained medical resources due to increased Covid-19 hospital admissions. Notwithstanding the importance of such factors, there is however some uncertainty regarding other factors that may lead to worsened clinical outcomes in cancer patients.

We aimed at tracing the characteristics and outcomes of both outpatient and hospital-admitted Covid-19 sufferers with a history or with actively treated BC at our Breast Unit.

Patients and Methods

Study Design

It was conceived as a unicentric cross-sectional, retrospective analysis.

As such, it was approved by the Hospital Universitari Mutua de Terrassa Review Board (N° O/21-094) under the consideration that it was dealing with an active population challenge.

Patients

The study group included patients aged over 20 with previous or active BC who were tested for Covid-19. Patients with both invasive and in situ tumors were included. These were compared with women from the general population receiving a SARS-CoV-2 test by the Catalan Health Service. The study was meant to span the whole year 2020 and the first trimester of 2021. The actual data collecting time window was from December 1, 2020, to March 30, 2021. Individual subject data were derived from the clinical records of our center, as well as from the online shared clinical record service of the Catalan Health Service and the official population statistical source service. (https://www.idescat.cat/ [Last consulted January 10, 2022]).

The Breast Unit database was refurbished to include certain Covid-19-related variables, including the SARS-CoV-2 test (CoT), either polymerase chain reaction (PCR) or rapid antigen lateral flow test (RT), date of CoT, patient age at CoT, the reason to test, type of CoT, CoT result, covid signs/symptoms in positive CoT subjects, and mortality, stating if at home or nursing home.

Statistics

Qualitative variables were expressed as numbers and percentages, while quantitative variables were expressed as mean value and standard deviation. For comparison of qualitative variables, the Chi-square test or the Fisher’s exact test was used, while for comparison of mean values the ANOVA test was used. Statistical significance was set at a $P < .05$ value, with a 2-tailed approach. Data were subjected to a univariate and multivariate logistic regression (LR) analysis using the SPSS statistical software v23.0 (SPSS Inc., Chicago, IL). As the predictive criterion, we considered a dichotomy variable defining mortality after COVID-19. Adequacy of model fitting was measured using the Hosmer–Lemeshow test. The predictive variables eventually used in our LR model were those variables shown to be statistically significant in the univariate analysis.

Results

Of the total 2511 BC patients older than 20 that were registered in our database, 1043 (41.5%) received at least one CoT. The total number of CoT was 1833, 1180 of which were PCR tests and 653 RT. The reference group included 2,625,958 women with a CoT.

COVID-19 Incidence

Confirmed Covid-19 infection amounted to 137 subjects out of 1043 BC cases (13.1%), whereas confirmed Covid-19 infection amounted to 7.1% of the feminine Catalan tested population, a statistically significant difference ($P < .001$). Table 1 shows the univariate analysis results of COVID-19 comorbidity factors in BC subjects.

COVID-19 Specific Mortality

The covid-19-specific mortality rate was 11.7% (16/137) in the study group, which compares with a 4.7% rate for the overall population, a statistically significant difference ($P < .001$).

Table 2 shows statistically significant factors for Covid-19 mortality according to the univariate analysis. These included age over 70, body mass index (BMI), tumor phenotype, distant metastases, lack of hormone therapy, and being a resident in a nursing home. Of note, most deaths occurred in non-smokers and abstemious women, both probably related to patient age. Variables that turned out significant in the univariate analysis were used as the base for the multivariate analysis, after which only distant metastases, lack of hormone therapy, and living in a nursing home kept their independent significance (Table 6).

Age and COVID-19 Mortality

Most COVID-19 deaths occurred beyond 70 years of age, both in the study group and in the reference group, with no statistical difference ($P = .55$). As for patients under 70, Covid-19 mortality was 0.8% in the reference group, and 6.3% in the study group, a statistically significant difference ($P < .001$), Table 3.

COVID-19 Mortality Time-Spread

Table 4 shows mortality rates at trimestral intervals. It can be seen that Covid-19 mortality occurred mostly during the first two trimesters of 2020 and was significantly higher for the study group ($P < .001$).

COVID-19 Home Deaths Versus Nursing Home Deaths

The mortality rate for subjects in the study group living in nursing homes was 12.5% (8/64), which was significantly higher than for patients living in their own homes, with a death rate of only 0.8% (8/978). This was a significant difference ($P< .001$) both in the univariate and multivariate analyses (Tables 4 and 6).
| Comorbidity Factors                      | Covid Negative n (%) | Covid Positive n (%) | P-value |
|------------------------------------------|----------------------|----------------------|---------|
| Age                                      |                      |                      | .635    |
| <50                                      | 107/121 (88.4)       | 14/121 (11.6%)       |         |
| 50-69                                     | 465/532 (87.4)       | 67/532 (12.6%)       |         |
| ≥ 70                                     | 334/390 (85.6)       | 55/390 (14.4%)       |         |
| Smoker                                   |                      |                      | .039    |
| No o ex > 10 y                           | 679/791 (85.8)       | 112/791 (14.2%)      |         |
| yes                                      | 217/240 (90.4%)      | 23/240 (9.6%)        |         |
| Alcohol intake                           |                      |                      | .058    |
| No                                       | 664/773 (85.9%)      | 109/773 (14.1%)      |         |
| yes                                      | 232/258 (89.9%)      | 26/258 (10.1)        |         |
| BMI                                      |                      |                      | .067    |
| < 25                                     | 320/357 (89.6)       | 37/357 (10.4%)       |         |
| ≥ 25                                     | 534/620 (86.1)       | 86/620 (13.9)        |         |
| pTNM                                     |                      |                      | .617    |
| pTis                                     | 79/95 (83.2)         | 16/95 (16.8%)        |         |
| I                                        | 408/466 (87.6)       | 58/466 (12.4%)       |         |
| IIA                                      | 196/226 (86.7)       | 30/226 (13.3%)       |         |
| IIB                                      | 102/120 (85)         | 18/120 (15%)         |         |
| III*                                     | 116/130 (89.2)       | 14/130 (10.8%)       |         |
| Histologic diagnosis                    |                      |                      | .167    |
| DCIS                                     | 79/95 (83.2)         | 16/95 (16.8%)        |         |
| Invasive Ca                              | 827/948 (87.2)       | 121/948 (12.8%)      |         |
| Phenotype                                |                      |                      | .110    |
| Luminal A                                | 319/361 (88.4)       | 42/361 (11.6)        |         |
| Luminal B (her2±)                        | 395/477 (88.4)       | 52/447 (11.6)        |         |
| Pure Her2                                | 35/42 (83.7)         | 7/42 (16.3)          |         |
| Triple negative                          | 79/99 (79.8)         | 20/99 (20.2)         |         |
| Local recurrence                         |                      |                      |         |
| No                                       | 821/946 (86.8)       | 125/946 (13.2)       | .397    |
| Yes                                      | 84/95 (88.4)         | 11/95 (11.6)         |         |
| Distant recurrence                       |                      |                      | .531    |
| No                                       | 863/994 (86.8)       | 131/994 (13.2%)      |         |
| Yes                                      | 43/49 (87.8)         | 6/49 (12.2%)         |         |
| Chemotherapy                             |                      |                      | .472    |
| No                                       | 410/473 (86.7)       | 63/473 (13.3)        |         |
| Yes                                      | 496/570 (87)         | 74/570 (13)          |         |
| Hormone therapy                          |                      |                      | .007    |
| No                                       | 115/144 (79.9)       | 29/144 (20.1%)       |         |
| Yes                                      | 791/899 (88)         | 108/899 (12.0%)      |         |
| Dwelling                                 |                      |                      | <.001   |
| Home                                     | 862/979 (88.1)       | 117/979 (11.9)       |         |
| Nursing home                             | 44/60 (66.7)         | 20/60 (33.3%)        |         |
| Months from BC diagnosis                 |                      |                      | .045    |
| ≤ 60 mo                                  | 294/326 (90.2)       | 32/326 (9.8%)        |         |
| 61-120 mo                                | 247/296 (83.5)       | 49/296 (16.5%)       |         |
| > 120 mo                                 | 365/421 (86.7)       | 55/421 (13.3%)       |         |
## COVID-19 Mortality Related Factors.

|                              | Alive n (%) | Death from COVID-19 n (%) | P-value |
|------------------------------|-------------|---------------------------|---------|
| **Age**                      |             |                           |         |
| <50                          | 120/121 (99.2) | 1/121 (0.8)              | .022    |
| 50-69                        | 528/532 (99.2) | 4/532 (0.8)               |         |
| ≥70                          | 379/390 (97.2) | 11/390 (2.8)              |         |
| **Smoker**                   |             |                           | .024    |
| No                           | 704/719 (97.9) | 15/719 (2.1)              |         |
| Yes                          | 311/312 (99.7) | 1/312 (0.3)               |         |
| **Alcohol intake**           |             |                           | .010    |
| No                           | 757/773 (97.9) | 13/773 (2.1)              |         |
| Yes                          | 258/258 (100) | 0/258 (0)                 |         |
| **BMI**                      |             |                           | .034    |
| < 25                         | 355/357 (99.4) | 2/357 (0.6)               |         |
| ≥ 25                         | 606/620 (97.7) | 14/620 (2.3)              |         |
| **pTNM**                     |             |                           | .924    |
| pTis                         | 91/92 (98.9) | 1/92 (1.1)                |         |
| I                            | 459/465 (98.7) | 6/465 (1.3)               |         |
| IIA                          | 224/227 (98.7) | 3/227 (1.3)               |         |
| IIB                          | 118/120 (98.3) | 2/120 (1.7)               |         |
| III*                         | 127/130 (97.7) | 3/130 (2.3)               |         |
| **Histologic diagnosis**     |             |                           | .564    |
| DCIS                         | 94/95 (98.9) | 1/95 (1.1)                |         |
| Ca invasive                  | 933/948 (98.4) | 15/948 (1.6)             |         |
| **Phenotype**                |             |                           | .031    |
| Luminal A                    | 355/361 (98.3) | 6/361 (1.7)               |         |
| Luminal B (her2±)            | 444/447 (99.3) | 3/447 (0.7)               |         |
| Pure Her2                    | 41/42 (97.6) | 1/42 (2.4)                |         |
| Triple negative              | 94/99 (94.9) | 5/99 (5.1)                |         |
| **Local recurrence**         |             |                           | .436    |
| No                           | 934/948 (98.5) | 14/948 (1.5)             |         |
| Yes                          | 93/95 (97.9) | 2/95 (2.1)                |         |
| **Distant recurrence**       |             |                           | .034    |
| No                           | 982/995 (98.7) | 13/995 (1.3)             |         |
| Yes                          | 45/48 (93.5) | 3/48 (6.5)                |         |
| **Radiation therapy**        |             |                           | .476    |
| No                           | 174/176 (98.8) | 2/176 (1.2)              |         |
| Yes                          | 853/867 (98.4) | 14/867 (1.6)             |         |
| **Chemotherapy**             |             |                           | .445    |
| No                           | 464/472 (98.3) | 8/472 (1.7)              |         |
| Yes                          | 563/571 (98.6) | 8/571 (1.4)              |         |
| **Hormone therapy**          |             |                           | .015    |
| No                           | 138/144 (95.8) | 6/144 (4.2)              |         |
| Yes                          | 889/899 (98.9) | 10/899 (1.1)             |         |
| **Dwelling**                 |             |                           | <.001   |
| Living place                 | 971/979 (99.2) | 8/979 (0.8)              |         |
| Geriatric residence          | 56/64 (87.5) | 8/64 (2.5)                |         |
| **Months from BC diagnosis** |             |                           | .145    |
| ≤ 60 mo                      | 324/326 (99.4) | 2/326 (0.6)              |         |
| 61-120 mo                    | 292/296 (98.6) | 4/296 (1.4)              |         |
| >120 mo                      | 411/421 (97.6) | 10/421 (2.4)             |         |
Along the first 5 trimesters, the Covid-19 mortality rate in nursing home residents from the reference population was 26.7% (5568/20,818) whereas the corresponding mortality rate for patients with BC was 40% (8/20), a non-statistically significant difference \((P = .181)\).

### COVID-19 Incidence and Mortality Rates in Infiltrating Versus In Situ Carcinoma Patients

The rate of Covid-19 infections was 12.8% (121/948) in patients with infiltrating carcinoma (IC), whereas such incidence was 16.8% (16/95) in patients with DCIS (Ductal carcinoma in situ); a nonsignificant difference \((P = .167)\). Covid-19 mortality rate was 1.6% (15/948) in IC patients and 1.1% (1/95) in DCIS patients, also a non-significant difference \((P = .564)\). On the other hand, both groups were homogeneous when age was considered: a mean of 56.2 ± 12 years (range 22-91) for IC patients, and 56 ± 9 years (range 30-86) for DCIS patients. Also, when nursing home dwelling was considered: 6.3% (60/948) for IC patients versus 4.2% (4/95) for DCIS patients \((P = .288)\).

### COVID-19 Mortality and Adjuvant Hormone Therapy

Indication of hormone therapy in our patients relies on the individual molecular subtype and only applies to those with tumors expressing estrogen and progesterin receptors. BC patients not receiving hormone therapy showed a significantly higher Covid-19 mortality rate than those receiving hormone therapies, both in the univariate and multivariate analysis (4.2% vs. 1.1%) \((P = .015)\) Tables 1 and 6. More broadly, patients with a positive hormone receptor (HR) status showed a 1% (9/808) mortality rate, while patients with a negative HR status (Pure Her2 and TN subtypes) showed a covid mortality rate of 4.3% (6/140), a statistically significant difference \((P = .032)\).

### COVID-19 Mortality and Pandemic Time Window

Both in BC patients and the reference group, Covid-19 mortality occurred mostly during the first two trimesters of 2020: 27.6% for the reference group and 75.9% for the BC group \((P < .001)\), Table 4.

### Covid-19-Related Comorbidity Conditions

Non-BC-related comorbidities in our patient group are displayed in Table 5. Hypertension, diabetes mellitus, respiratory diseases, and increased BMI are quite prevalent.

### COVID-19 Epidemiological Factors (Table 1)

- **Age.** The mean age of BC patients with a CoT was 65 ± 13 (SD) years, with a range of 25 to 101 years.
- **Living.** 93.9% of BC patients lived in their own homes, and 6.1% at a nursing home
- **Clinical Presentation.** Out of the 137 BC with a positive CoT, 16.1% were asymptomatic, 57.7% had mild symptoms, and 26.3% had pneumonia. Of those living at home, 20.5% were admitted to
hospital, while of those living in a nursing home 25% were admitted ($P = .421$). Hospital admissions amounted to 21.2% of BC patients with a positive CoT.

### Discussion

COVID-19 hospital admissions have been a matter of debate in our context, especially when elderly patients living in nursing homes were concerned. The overall admission rate in our survey of COVID-19 positive BC patients was 21%, which compares with the much higher rate of 47% in the study by Vuagnat et al in Paris,12 and 48% in the CCC19 study.4 Notably, only a quarter of Covid-19-infected nursing home BC patients in our study were finally admitted to the hospital.

The Covid-19 mortality rate in our BC cohort was 11.7%, which is similar to the rate reported by the CCC19 consortium of 9% at 30 days.1 Our mortality rate was higher than the reported cumulative mortality figure for the feminine Catalan population over 20 years of age in the same period, which was 3.6%.17

Covid-19 mortality in patients with BC seems to concentrate mainly on subjects over 70, as already reported4,18 even though the most hard-hit age tier was for patients over 80. For BC patients under 70, mortality rates were considerably lower, just as has been reported for the general feminine Catalan population.17 Of the several comorbid conditions considered in epidemiological studies and predictive models, age has been shown the most significant independent factor for Covid-19 infection and mortality compared with the rest: body weight (patients with a BMI over 25 shows significantly higher mortality), hypertension, type II diabetes, cancer, dementia, heart disease, autoimmune disease, or other respiratory conditions such as asthma. Of note, neither cigarette smoking nor alcohol intake was related to increase Covid mortality in BC patients.19 Other factors unrelated to Covid mortality were

### Table 5 Epidemiological and Clinical Characteristics of BC Patients Who Died From COVID-19

| n  | Age | Dwelling    | Hospital Admission | Trimester | Presentation | Distant Metastases | BMI  | Comorbidity                |
|----|-----|-------------|-------------------|-----------|--------------|--------------------|------|---------------------------|
| 1  | 73  | home        | yes               | 1T20      | Pneumonia    | no                | 32.0 | HBP, TIIDM, Asthma        |
| 2  | 87  | home        | yes               | 2T20      | Pneumonia    | no                | 25.9 | None                      |
| 3  | 90  | nursing home| no                | 2T20      | Pneumonia    | no                | 31.6 | HBP, TI DM                |
| 4  | 79  | nursing home| no                | 2T20      | Pneumonia    | no                | 24.2 | Heart fail, COPD, R Arthritis |
| 5  | 79  | nursing home| yes               | 2T20      | Pneumonia    | no                | 24.2 | HBP, TI DM                |
| 6  | 88  | nursing home| yes               | 2T20      | Pneumonia    | no                | 27.5 | HBP, Asthma, TII DM       |
| 7  | 80  | home        | yes               | 2T20      | Pneumonia    | no                | 40.8 | HBP, TI DM, heart dis.    |
| 8  | 79  | nursing home| no                | 2T20      | Pneumonia    | no                | 29.7 | HBP, TI DM                |
| 9  | 65  | home        | yes               | 2T20      | Pneumonia    | no                | 26.2 | None                      |
| 10 | 53  | home        | yes               | 2T20      | Pneumonia    | yes               | 29.9 | Mets                      |
| 11 | 41  | home        | yes               | 2T20      | Pneumonia    | yes               | 33.7 | Mets                      |
| 12 | 87  | nursing home| no                | 2T20      | Pneumonia    | no                | 27.0 | HBP                      |
| 13 | 59  | home        | yes               | 4T20      | Pneumonia    | yes               | 34.4 | cig. smoker               |
| 14 | 76  | nursing home| no                | 4T20      | Pneumonia    | no                | 32.0 | dementia                  |
| 15 | 85  | nursing home| no                | 4T20      | Pneumonia    | no                | 29.7 | HBP                      |
| 16 | 69  | home        | yes               | 1T21      | Pneumonia    | no                | 26.3 | Recurrent Myeloma         |

Mean or %: 38% nursing home, 62% home; 38% no admission; 100% pneumonia; 19% yes metastasis; 94% yes morbidity

### Table 6 Results From the Multiple Regression Mortality Factors Analysis Based on Significant Variables From the Univariate Analysis

|                         | Constant | Signific | OR   | 95% CI. for EXP (OR) |
|-------------------------|----------|----------|------|----------------------|
| Distant metastases      | 2.097    | 0.007    | 8.143| 1.785, 37.148        |
| Hormone therapy         | -1.360   | 0.019    | 0.257| 0.083, 0.797         |
| Dwelling                | 2.611    | 0.000    | 13.616| 3.410, 54.376        |
the BC stage at the time of operation, local recurrence, and a diagnosis of IC versus intraductal carcinoma. Covid-19 mortality in our study group was conspicuously higher for patients living in nursing homes, albeit with no differences when compared with the reference group. These are figures pretty similar to the reported 38.7% rate by a Connecticut study and lead us to consider that the fact of being a nursing home resident is in itself the most significant factor for Covid-19 mortality in BC patients.

Some authors have suggested that Covid-19 mortality differences are linked to BC-related conditions, such as immunosuppression or metastatic spread. In our study, metastatic disease has proved to be the most significant cancer comorbidity factor for Covid-19 mortality. Of note, neither chemotherapy nor the time elapsed between BC diagnosis and Covid-19 infections has been associated with increased mortality, suggesting that patients treated with chemotherapy in our series did not have substantial immunosuppression for long enough to render covid-19 more deadly. Although lack of hormone therapy was a significant variable according to our multivariate analysis, it seems to be related only to the negative HR status in patients with subtypes Her2 and TN, which are also associated with higher rates of distant metastases.

In short, BC patients living in their own homes without distant metastases are at the same risk for Covid death as the general population.

Limitations
Because ours was a rather short and fixed data collecting time window from December 1, 2020, to March 30, 2021, this has resulted in a rather standard cross-sectional study where any inference may be difficult to apply. Both incidence and prevalence of Covid-19 change as the pandemic evolves and are dependent on the number of patients being considered over time. During that particular time window, some conversion from negative to positive CoT tests might have happened that could have had an impact on our results. Unfortunately, our database does not thoroughly include medical comorbid conditions unrelated to BC that might have influenced covid-19 incidence and mortality results.

Clinical Practice Points
– BC patients had higher incidence of COVID-19 infection and mortality compared to control group (13.1% vs 11.7% and 7.1% vs 4.7%).
– Mortality rates were higher in nursing home patients older than 70 years, and mainly happened during the first six months of the pandemic event.
– Distant metastases and living in a care home were the only independent predictive factors for COVID-19 mortality in BC patients.

Comment
According to our multivariate analysis, distant metastases and living in a nursing home are the only independent predictive factors for Covid-19 mortality in BC patients.

Author Contributions
“All authors contributed to the study conception and design as well as to Material preparation, data collection, and analysis. The first draft of the manuscript was written by [Carolina Chabreja] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.”

Data Availability
Data from the general population can be found at https://www.idescat.cat/pub/?id=covid.

Data from our study of patients are not available in the public domain; however, they can be accessed under the request of Doctor Antonio García-Fdez, who is responsible for the database of the Breast Unit at the Hospital Universitari Mutua de Terrassa.

Consent to Participate and Publication
All patients gave their written consent shortly before breast surgery so that their anonymized individual data, including those from clinical follow-up, could be used for scientific purposes.

Acknowledgments
The authors wish to thank Mr Manel Martori for helping us with the graphic design, to the members of the Breast Unit, and finally to the staff of the Breast Cancer Screening Unit: Cristina, Sandra, and Clara; all of whom were essential contributors to keeping our breast cancer database updated.

Disclosure
The authors have no relevant financial or non-financial interests to disclose.

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