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Review of risk of COVID-19 in cancer patients and their cohabitants

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ABSTRACT

Background: Patients with a history of active malignancy are at increased risk of infection and COVID-19-related complications. Sanitary protection measures are not specifically recommended within households. This study examined the risk of seroconversion in cancer patients according to their household exposure.

Patients and methods: This seroprevalence study was a prevalence study conducted in Torrejón de Ardoz (Spain). It analysed the seroprevalence of IgM and IgG antibodies in 104,299 volunteers (participation rate of 74.8% of population) from 29 May to 05 June 2020. Personal authorisation was requested to collect by questionnaire the test results from cancer patients, who attended the Outpatient Department of the University Hospital of Torrejón, and their cohabitants between 01–19 June 2020.

Results: A total of 229 cancer patients were included in the study. Sixty-four of the 229 individuals tested positive for SARS-CoV-2 IgG antibodies (27.9%) and 22 were positive for SARS-CoV-2 IgM antibodies (9.6%). The overall seroprevalence (IgG or IgM positive) was 31.4% (general population seroprevalence was 10% in Spain). Of 72 seropositive patients, 54.2% had intrafamilial exposure vs 45.8% who did not. Among seronegative patients, 30.6% had seropositive cohabitants. The probability of seropositivity for a cancer patient was significantly related to intrafamilial exposure (OR 2.684, 95% CI 1.51–4.76, p = 0.001).

Conclusions: Cancer patients are a high-risk group for SARS-CoV-2 infection. Recommendations against virus transmission need to be implemented even in a household scenario, as it was the main factor significantly related to seroconversion.

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Value of this study

The secondary attack rate of SARS-CoV-2 in households is 16.3%. The ages of household contacts and spousal relationship to the index case are risk factors for transmission of SARS-CoV-2 within a household. Quarantine of index patients at home since the onset of symptoms is useful in preventing the transmission of SARS-CoV-2 within a household (Li et al., 2020). In the case of non-household close contacts, sharing a vehicle, verbal interaction and contact with more than one index case are risk factors independently associated with SARS-CoV-2 transmission. The serology results of 229 cancer patients and their cohabitants participating in the population-based seroprevalence study in the city of Torrejón de Ardoz were reviewed. The study included cancer patients who had symptomatic COVID-19 disease and those who were asymptomatic. Symptom-based PCR misses a lot of SARS-CoV-2 asymptomatic cases. Close contact tracing is one of the backbones of the control of transmission of SARS-CoV-2, as this is the only way to identify asymptomatic cases.

Available evidence and its implications

The available findings, including those from this study, support physical distancing and minimising verbal interactions as part of community measures for preventing SARS-CoV-2 transmission among close contacts. Testing of close contacts, regardless of symptoms, reduces missed diagnoses and is very important in cases of high-risk patients such as cancer patients. Household contacts, who are at high risk of SARS-CoV-2 transmission, should be prioritised for routine testing. Detection of SARS-CoV-2-
positive household contacts would prompt either relocation of the person out of the household or implementing physical distancing and other infection prevention measures within the household.

Introduction

The ongoing COVID-19 pandemic, caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has affected almost all countries worldwide. COVID-19 was first reported in Wuhan, China, in December 2019, among a group of individuals presenting with atypical pneumonia of unknown aetiology (Lu et al., 2020). To date (24 January 2021) there have been >9,264,519 reported cases and 2,107,554 deaths due to COVID-19 (World Health Organization, 2020). Individuals aged >70 years and patients with chronic conditions such as diabetes, hypertension or cardiopulmonary disease are at higher risk of severe disease complications and death (Wu and McGoogan, 2020). However, the spectrum of disease severity and mortality from COVID-19 and the risk factors related to SARS-CoV-2 are unknown because of limitations of routine case detection and surveillance systems.

Reverse-transcription PCR tests fail to identify asymptomatic infections or mild cases that do not present to healthcare systems (Gudbjartsson et al., 2020; McMichael et al., 2020). Therefore, seroprevalence studies are critical to detect the extent of infection in the community, to help define public health strategies and protect especially vulnerable populations.

Published data suggest that patients with a history of active malignancy are at increased risk of infection and COVID-19-related complications. Data from China have shown that cancer patients infected with COVID-19 are 3.5 times more at risk of requiring mechanical ventilation or intensive care unit (ICU) admission compared with the general population (Liang et al., 2020; Dai et al., 2020). In a cohort study, 928 cancer patients (39% on active anticancer treatment, 43% with active cancer) were analysed, with a 30-day all-cause mortality of 13%. The mortality was associated with general risk factors and risk factors unique to patients with cancer, such as age, sex or active neoplasm, but not with the cancer treatment itself (Kuderer et al., 2020). According to those data, most clinical oncology scientific societies have recommended putting on hold the oncologic treatment in recently diagnosed patients. In SARS-CoV-2-negative patients, treatment should be carefully considered, unless a patient’s condition is life-threatening in the short term, clinically unstable or the magnitude of benefit qualifies the treatment as a high priority (e.g. significant overall survival gain and/or substantial improvement in quality of life) (American Society of Clinical Oncology (ASCO), 2020 European Society of Medical Oncology (ESMO), 2020). Specifically, if the risk of SARS-CoV-2 infection is higher than the treatment benefit, it should be delayed until the risk-benefit balance is beneficial. Therefore, it is very important to be aware of the regional prevalence of COVID-19 (Sociedad Española de Oncología Médica, 2020).

Isolation of confirmed COVID-19 cases and quarantine of close contacts are recommended to improve disease control in almost all countries with COVID-19 outbreaks. Such restrictions have little effect on transmission within households, where protection recommendations are not usually implemented. This is an important gap in the mitigation strategies, as symptomatic or asymptomatic carriers can transmit the virus (Bai et al., 2020; He et al., 2020; Rothe et al., 2020). In studies of contact tracing in the cities of Shenzhen and Guangzhou (China), the secondary attack rates were 14.9% and 10.2%, respectively, among household contacts. In a study of the close contacts of 10 US patients with COVID-19, the estimated household secondary attack rate was 10.5% (Bi et al., 2020; Burke et al., 2020). However, these were general population studies and not cancer patient populations, the sample size was small for reliable interpretation and only symptom onset of primary cases was examined.

Since the start of the COVID-19 alert and until 21 June 2020 (health alert end), 1,432,072 cases of SARS CoV-2 infection have been diagnosed by PCR in Spain (Instituto de Salud Carlos III, 2020) with 283,625 cases (19.8% cases registered in the country) diagnosed in the region of Madrid (Sociedad Española de Oncología Médica, 2020). ENE-Covid19 is a large population-based sero-epidemiological longitudinal study; the objectives are to estimate the prevalence of SARS-CoV2 infection by determining antibodies against the virus in Spain and evaluating its temporal evolution. The results presented in the first round (27 April–11 May) included 60,983 participants. The estimated prevalence of IgG antibodies against SARS-CoV2 in Spain was 5% (95% CI 4.7–5.4%) and 11.3% (95% CI 9.8–13%) in Madrid (Pollán et al., 2020). At the University Hospital of Torrejón on 16 June 2020, 1098 cases of COVID-19 had been diagnosed, with a total cumulative incidence of 453 cases per 100,000 inhabitants in December 2020 and a maximum incidence of 835 per 100,000 inhabitants in May 2020.

This study aimed to investigate the risk of seropositivity in cancer patients according to their household exposure. It traced the patients who had positive serology and the serological results of their cohabitants. The main hypothesis was that there is a high risk of virus transmission at home because patients do not use preventive measures, and oncologic patients frequently need to go to the hospital to receive their treatment, so they are more exposed than the general population to SARS-CoV-2 infection. The seroprevalence study ENE-Covid19 monitored a cohort of close contacts and provided a unique opportunity to study attack rates based on serological surveys in symptomatic or asymptomatic patients. The results of the prevalence of IgG and IgM antibodies against SARS-CoV-2 in cancer patients from the University Hospital of Torrejón (Madrid, Spain) related to the in-house exposure to cohabitants who had COVID-19 or have antibodies against the disease are presented.

Methods

Study design and participants

The SARS-CoV-2 seroprevalence study was a cross-sectional study in Torrejón de Ardoz, (Madrid, Spain) carried out by the council of Torrejón de Ardoz (Ayuntamiento de Torrejón, 2020). It included all citizens aged >1 year who were interested in taking the serological test. From a total of 139,452 registered citizens, 104,299 volunteers participated (74.8% of the population). The study was undertaken between 29 May and 05 June 2020, after approval of the institutional ethics boards at Elche-Vinalopó and Torrevieja Hospital (Comunidad de Valencia, Spain). Individuals with positive IgM were directed to SARS-CoV-2 nucleic acid by real-time RT-PCR, regardless of whether they were symptomatic or not. All individuals diagnosed with COVID-19 were admitted to hospital if they had moderate or severe symptoms and isolated until they were discharged, following at least two consecutive negative PCR tests on respiratory specimens collected 24 h apart.

Using this information, a retrospective cohort study was performed at the centre to evaluate the rate of seropositivity among cancer patients at the institution, and its relation to seropositive cohabitants. Authorisation was requested to collect the serological test results from cancer patients who attended the Outpatient Department of the University Hospital of Torrejón and their cohabitants between 01–19 June 2020.
Asymptomatic individuals were defined as those who reported no symptoms at all. Household contacts were defined as those who shared the same home as the index case, regardless of duration of contact. Cancer patients were classified according to if they were seropositive or not, the kind of treatment they were receiving and if they had seropositive household contacts or not. A total of 229 patients were included. All participants gave written informed consent before their participation in the study.

Laboratory analysis of anti-SARS-CoV-2 IgG and IgM antibodies was assessed using a commercially available rapid test (Testsealabs® IgG/IgM Rapid Test Cassette, Hangzhou Testsealab Biotechnology Co., Ltd) targeting the S1 domain of the spike protein of SARS-CoV-2. The serological test has the following characteristics: sensitivity (IgM 88%; IgG 96%), specificity (IgM 100%; IgG 100%) and accuracy (IgM 94%; IgG 98%). The test is based on reliability studies carried out in various hospitals of the Spanish National Health System, and has the approval of the European Community and the ISO13485 certificate. The following studies were carried out to validate the test as an instrument for measuring health: a validation study of the selected test, before carrying out the study in a sample of randomly selected healthcare workers. The results were compared with the ELISA technique, with the aim of obtaining a gross agreement of >80% for both measure. A concordance study was performed on a randomly selected sample, which was performed (in addition to the serological test) to detect antibodies using ELISA techniques, with the aim of obtaining a kappa index >0.7. A concordance study was conducted with patients diagnosed at the Torrejón Hospital by PCR before the start of the study and who had had serological tests (the required objective was to obtain a crude concordance >95%). The validation study showed a diagnostic agreement of 93.6% between the Testsealabs® and ELISA tests.

Intrafamilial exposure was defined as having one or more cohabitant(s) in the same household with IgM or IgG antibodies against SARS-CoV-2. A patient or cohabitant was considered seropositive when presenting with IgM or IgG antibodies against SARS-CoV-2; otherwise they were considered seronegative. A previous study had analysed the clinical characteristics of this cohort, which are published elsewhere (Cabezón-Gutiérrez et al., 2020) and the results of the Council population study were published on 17 June 2020 (Ayuntamiento de Torrejón, 2020).

Statistical analysis

Statistical calculations were performed using SPSS version 26. A comparison between categorical variables was computed using

| Characteristic                                      | SARS-COV2 seropositive (n = 72) | SARS-COV2 seronegative (n = 157) | P-value |
|----------------------------------------------------|---------------------------------|----------------------------------|---------|
|                                                    | n  | %    | n  | %    |         |
| Intrafamiliar exposure                             | 39 | 54%  | 48 | 30%  | 0.526   |
| Non-intrafamiliar exposure                         | 33 | 46%  | 109| 70%  | 0.904   |
| Age group                                          |    |      |    |      |         |
| <50 (n = 35)                                       | 11 | 31.4%| 24 | 68.6%|         |
| 51–70 (n = 122)                                    | 41 | 33.6%| 81 | 66.4%| 0.7     |
| >70 (n = 72)                                       | 20 | 27.8%| 52 | 72.2%|         |
| Sex                                                |    |      |    |      | 0.317   |
| Male (n = 105)                                     | 37 | 35.2%| 68 | 64.8%|         |
| Female (n = 124)                                   | 35 | 28.2%| 89 | 71.8%|         |
| Cancer type                                        |    |      |    |      |         |
| Respiratory and Intrathoracic organs (n = 35)      | 14 | 40%  | 21 | 60%  |         |
| Digestive organs (n = 64)                          | 15 | 23.4%| 49 | 76.6%|         |
| Breast (n = 67)                                    | 21 | 31.3%| 46 | 68.7%|         |
| Urinary tract and male genital organs (n = 33)     | 11 | 33.3%| 22 | 66.7%| 0.426   |
| Female genital organs (n = 15)                     | 7  | 46.7%| 8  | 53.3%|         |
| Other (n = 15)                                     | 4  | 26.7%| 11 | 73.3%|         |
| Cancer stage                                        |    |      |    |      |         |
| Primary tumour localised/locally advanced (n = 150) | 47 | 31.3%| 103| 68.7%|         |
| Metastatic (n = 79)                                 | 25 | 31.6%| 54 | 68.4%| 0.961   |
| Cancer treatment during COVID-19 pandemic           |    |      |    |      |         |
| Chemotherapy (n = 59)                              | 16 | 27.1%| 43 | 72.9%|         |
| Non-chemotherapy treatment (n = 78)                | 30 | 38.5%| 48 | 61.5%| 0.256   |
| None (n = 92)                                      | 26 | 28.3%| 66 | 71.7%|         |
| Pneumonia                                          |    |      |    |      | 0.002   |
| No (n = 217)                                       | 63 | 29%  | 154| 71%  |         |
| Yes (n = 12)                                       | 9  | 75%  | 3  | 25%  |         |
Fisher’s exact test or Pearson Chi-squared test. A p-value of <0.05 was considered statistically significant. The following predictors were evaluated for inclusion in a final multivariable model using invariable binary logistic regression analysis: age group (<50, 51–70, >70 years), sex (female and male), cancer type (respiratory, digestive, breast, urinary and male genital organs, female genital organs, and others), and cancer treatment (yes/no). A relaxed level significance (p < 0.6) was used to identify variables. Goodness-of-fit of the model was evaluated by the Hosmer-Lemeshow test. To estimate the degree of the association, odds ratios (OR) and respective 95% confidence intervals (95% CI) were calculated.

**Results**

**General characteristics**

A total of 229 cancer patients were included in the study: 64 tested positive for SARS-CoV-2 IgG antibodies (27.9%) and 22 were positive for SARS-CoV-2 IgM antibodies (9.6%). An overall seroprevalence (IgG or IgM positive) of 31.4% was estimated (Cabezón-Gutiérrez et al., 2020).

General characteristics of the study population were as follows: the proportion of men and women was well balanced and the mean age was 64 years (range 42–88); 84.7% of the study population were aged >50 years; and 137 (59.8%) were on active cancer treatment (25.8% chemotherapy, 18.8% hormone therapy, 4.3% immunotherapy and 10.9% target therapy) (Table 1). Tumour location and its cancer stage were not significantly related to seropositivity for SARS-CoV-2. It is of note that neither active treatment nor absence of it during the COVID-19 pandemic was significant for seropositivity. The rates of seropositivity are presented in Table 2.

**Cancer patients and intrafamilial exposure**

Of the 72 seropositive patients, 54.2% had intrafamilial exposure (cohabitants who were seropositive for SARS-CoV-2 IgM or IgG antibodies) vs 45.8% who did not have. Among seropositive patients, 30.6% had cohabitants who had antibodies against SARS-CoV-2. The probability of seropositivity for a cancer patient was significantly related to intrafamilial exposure (OR 2.684, 95% CI 1.51–4.76, p = 0.001).

**Cancer treatment and intrafamilial exposure**

Sixteen of the 72 seropositive patients (22%) were receiving chemotherapy and seven (43%) of them had familial exposure. Among patients on active anticancer treatment with molecular targets, hormonotherapy or immunotherapy, 14 (46.7%) had seropositive cohabitants. Eighteen (69%) seropositive patients were not receiving active treatment and had familial exposure, and eight (30.8%) patients with SARS-CoV-2 antibodies were without any active treatment and did not have familial exposure. Among 157 seronegative patients, 43 of them were on chemotherapy treatment. Forty-eight of them (30.5%) lived with seropositive cohabitants. Fourteen seronegative patients (29.2%) were receiving immunotherapy, targeted therapy or hormonotherapy and had familial exposure (Figures 1 and 2). Most cohabitants (86.5%) were asymptomatic and diagnosed as having had exposure to the virus by a serology test. Among the study patients, there were 12 cases of pneumonia. Three of them had negative PCR and pneumonia not compatible with COVID-19. Nine had positive PCR at the time of their diagnosis. Four patients with COVID-19 pneumonia were on chemotherapy, three were receiving targeted therapy and two of them were not receiving any active treatment. The multivariable analysis confirmed that having seropositive cohabitants was the only risk factor for cancer patients to be seropositive themselves (OR 2.69, 95% CI 1.47–4.9, p = 0.01) (Figure 1).

**Discussion**

The high seropositivity rate among cancer patients detected in this study (overall seropositivity for IgG or IgM of 31.4%) and the risk factor of having seropositive cohabitants indicate that this population was more exposed to the virus infection than the general population (seroprevalence of 5% in Spain and 11.3% in Madrid) (Pollán et al., 2020).

When individually asked for data, the cancer patients were a social cohort that had strictly followed the prevention recommendations against COVID-19 spread such as social distancing of at least 1.5 m, frequent hand washing and the use of protective masks, which were recommended in Spain during the first wave of the
COVID-19 outbreak. They also reported that the recommendations were not followed in their homes, and this is one of the weaknesses of the protection. Hence, it is suspected that cancer patients could be mostly exposed to the virus because of intrafamilial exposure or during their visits to the hospital for anticancer treatment (although since March 2020 all patients at the hospital respected the protective measures, and the oncology area was isolated form the rest of the activities).

It is believed that there is no registry of seroconversion of cancer patients according to their household exposure to SARS-CoV-2. The published studies include family clusters and mainly their clinical characteristics (Jing et al., 2020; Qian et al., 2020; Yong et al., 2020; Yu et al., 2020). Several studies have shown that cancer patients had more complications due to COVID-19 and were a high-risk population (Liang et al., 2020; Onder et al., 2020; Garassino et al., 2020). The risk factors described in those studies were age, being male, smoker status, Eastern Cooperative Oncology Group status, and active cancer. Neither treatment nor surgery were shown to be risk factors for COVID-19 severity (Gudbjartsson et al., 2020).

In Spain, the first-wave strict lockdown lasted 99 days. If a case of SARS-CoV-2 infection was detected, 14 days of in-house isolation was strongly recommended. It was better if this isolation could be made in a different house, but most patients did not have this option, so isolation was done in the same house as their close relatives. Liu et al. carried out a study of seroconversion in cancer patients and suggested a lower capacity for seroconversion in this group of patients (Liu et al., 2020). The main explanation was that this population is immunosuppressed. In the current study, 31.4% of patients presented seroconversion, which is a much higher prevalence than that shown in the nationwide seroprevalence study ENE-COVID (Pollán et al., 2020). Ng et al. studied transmission risk factors among high-risk contacts. They defined in-house risk factors as sharing a bedroom (multivariable OR 5.38, 95% CI 1.82–15.84, p = 0.0023) and being spoken to by an index case for ≥30 min (OR 7.86, 95% CI 3.86–16.02, p < 0.0001). Among non-household contacts, exposure to more than one case (multivariable OR 3.92, 95% CI 2.07–7.40, p < 0.0001), being spoken to by an index case for ≥30 min (OR 2.67, 95% CI 1.21–5.88, p = 0.015) and sharing a vehicle with an index case (OR 3.07, 95% CI 1.55–6.08, p = 0.0013) were associated with SARS-CoV-2 transmission. Among both household and non-household contacts, indirect contact, meal sharing and lavatory co-usage were not independently associated with SARS-CoV-2 transmission (Ng et al., 2020).

Eighty-seven of the 229 participants in the current study had seropositive cohabitants, and 72 (31.4%) presented antibodies against SARS-CoV-2. It is assumed that they were exposed to the virus at some point of the lockdown (serological tests at Torrejón de Ardoz were performed between 29 May and 05 June 2020, and the lockdown lasted from 15 March to 21 June 2020). These data suggest that close household contact may be the main risk factor for virus transmission, with a 54.2% risk of SARS-CoV-2 seropositivity if intrafamilial exposure existed (OR 2.684, 95% CI 1.51–4.76, p = 0.001).

The main limitations of this study were the number of patients that were included and it was limited to outpatients, which could have led to selection bias, since only those patients who felt well enough could undergo the serology analysis and come to an oncology consultation. There was no control group based on the study of Torrejón Council because people who underwent the serology tests but were not patients could not be contacted due to the personal data protection law.

In conclusion, cancer patients are a high-risk group for SARS-CoV-2 infection, and could need to implement recommendations against virus transmission even in a household scenario.

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The authors of this manuscript have no conflict of interest.

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Magda Palka-Kotlowska: Conceptualization, Writing - original draft, Writing - review & editing. Supervision. Sara Custodio-Cabello: Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing. Eduardo Olveros-Acebes: Methodology. Parham Khosravi-Shahi: Formal analysis, Investigation, Supervision. Luis Cabezón-Gutierrez: Conceptualization, Methodology, Writing - original draft, Writing - review & editing. Supervision.

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References

American Society of Clinical Oncology (ASCO). ASCO special report: a guide to cancer care delivery during the COVID-19 pandemic. Updated May 19. [Accessed 14 July 2021] 2020. https://www.asco.org/sites/new-www.asco.org/files/content-files/2020-ASCO-Guide-CancerCOVID19.pdf.

Ayuntamiento de Torrejón. [Internet]. [Torrejón de Ardoz, Spain]: Ayuntamiento de Torrejón [2020]. Estudio de Seroprevalencia de Torrejón de Ardoz; cited 10 Jan 21; [about 1 screen]. Available from: https://www.ayto-torrejon.es/noticia/nota-de-prensa/el-estudio-de-seroprevalencia-de-torrejon-de-ardoz-revela-unanueva-prevalencia-de-spanish.

Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, et al. Presumed asymptomatic carrier transmission of COVID-19. JAMA 2020;323(April 14):1406–7.

Bi Q, Wu Y, Mei S, Ye C, Zou X, Zhang Z, et al. Epidemiology and transmission of COVID-19 in 91 cases and 1286 of their close contacts in Shenzhen, China: a retrospective cohort study. Lancet Infect Dis 2020;20(August 9(3)):911–9.

Burke RM, Midgley CM, Dratch A, Fenstersheib M, Hauto T, Holshue M, et al. Active monitoring of persons exposed to patients with confirmed COVID-19—United States, January–February 2020. Morb Mortal Wkly Rep 2020;69(March 9(9)):245–6.

Cabezón-Gutierrez L, Custodio-Cabello S, Palka-Kotlowska M, Olveros-Acebes E, García-Navarro MJ, Khosravi-Shahi P. Seroprevalence of SARS-CoV-2-specific antibodies in cancer outpatients in Madrid (Spain): a single center, prospective, cohort study and a review of available data. Cancer Treat Rev 2020;90 (November):102102.

Dai M, Liu D, Liu M, Zhou F, Li G, Chen Z, et al. Patients with cancer appear more vulnerable to SARS-CoV-2: a multicenter study during the COVID-19 outbreak. Cancer Discov 2020;10(June 6):783–91.

European Society of Medical Oncology website (ESMO). Cancer patient management during the Covid-19 pandemic. [Accessed 14 July 2020]. 2020. https://www.esmo.org/guidelines/cancer-patient-management-during-the-covid-19-pandemic.

Garassino MC, Whisenant JG, Huang LC, Trama A, Torri V, Agustoni F, et al. COVID-19 in patients with thoracic malignancies (TERAVolt): first results of an international, registry-based, cohort study. Lancet Oncol 2020;21(July 7):914–22.

Gudbjartsson DF, Helgason A, Jonsson H, Magnusson OT, Meldsted P, Norddahl GL, et al. Spread of SARS-CoV-2 in the Icelandic population. N Engl J Med 2020;382 (June 24(2302)):15–25.

He X, Lau EHY, Wu P, Deng X, Wang J, Hao X, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med 2020;26(May 5(5)):672–5.

Instituto de Salud Carlos III. Informe 55 sobre situación de COVID en España. 2020. https://www.isciii.es/quehacemos/servicios/vigilanciasaludpublica/RENAVE/EnfermedadesTransmisibles/Documents/INFORMES/Informes%20COVID-19/Informe%20COVID-19-%20ON%C3%ADAS%20D%20Diciembre%20de%202020.pdf.

Jing QL, Liu MJ, Zhang ZB, Fang LQ, Yuan J, Zhang J, et al. Household secondary attack rate of COVID-19 and associated determinants in Guangzhou, China: a retrospective cohort study. Lancet Infect Dis 2020;20(October 10(10)):1141–50.

Kuderer NM, Choueiri TK, Shah DP, Shyr Y, Rubinstein SM, Rivera DR, et al. Clinical impact of COVID-19 on patients with cancer (CC19): a cohort study. Lancet 2020;395(June 10241(2021)):1807–18.
Li W, Zhang B, Lu J, Liu S, Chang Z, Peng C, et al. Characteristics of household transmission of COVID-19. Clin Infect Dis 2020;71(November (8)):1943–6.

Liang W, Guan W, Chen R, Wang W, Li J, Xu K, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. Lancet Oncol 2020;21(March (3)):335–7.

Liu T, Zeng G, Tao H, Shi Y, COVID-19 in Cancer Patients Research Group, Wang T, et al. Low prevalence of IgG antibodies to SARS-CoV-2 in cancer patients with COVID-19. Int J Cancer 2020;147(December (11)):3267–9.

Lu H, Stratton CW, Tang YW. Outbreak of pneumonia of unknown etiology in Wuhan, China: the mystery and the miracle. J Med Virol 2020;92(April (4)):401–2.

McMichael TM, Currie DW, Clark S, Pogosjans S, Kay M, Schwartz NG, et al. Epidemiology of Covid-19 in a long-term care facility in King County, Washington. N Engl J Med 2020;382(May (21)):2005–11.

Ng OT, Marimuthu K, Koh V, Pang J, Lim KZ, Sun J, et al. SARS-CoV-2 seroprevalence and transmission risk factors among high-risk close contacts: a retrospective cohort study. Lancet Infect Dis 2020;(November) S1473-3099(20)30833-1.

Onder G, Rezza G, Brusalerro S. Case-fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. JAMA 2020;323(May (18)):1775–8.

Pollán M, Pérez-Gómez B, Pastor-Barriuso R, Oteo J, Hernán MA, Pérez-Olmeda M, et al. Prevalence of SARS-CoV-2 in Spain (ENE-COVID): a nationwide, population-based seroepidemiological study. Lancet 2020;396(August (10250)):535–44.

Qian G, Yang N, Ma AHY, Wang L, Li G, Chen X, et al. COVID-19 transmission within a family cluster by presymptomatic carriers in China. Clin Infect Dis 2020;71(July (15)):861–2.

Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallrauch C, et al. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. N Engl J Med 2020;382(March (10)):970–1.

Sociedad Española de Oncología Médica (SEOM). Asistencia a pacientes oncológicos y hematológicos post-Covid-19 (julio 2020). Updated June. [Accessed 14 July 2020].

World Health Organization. WHO coronavirus disease (COVID-19) dashboard. 2020. https://covid19.who.int.

Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA 2020;323(April (13)):1239–42.

Yong SE, Anderson DE, Wei WE, Pang J, Chia WN, Tan CW, et al. Connecting clusters of COVID-19: an epidemiological and serological investigation. Lancet Infect Dis 2020;20(July (7)):809–15.

Yu P, Zhu J, Zhang Z, Han Y. A familial cluster of infection associated with the 2019 novel coronavirus indicating possible person-to-person transmission during the incubation period. J Infect Dis 2020;221(May (11)):1757–61.