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Short communication

Risk of hospitalization for self-harm among adults hospitalized with SARS-CoV-2 in France: A nationwide retrospective cohort study

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ABSTRACT

While much work has shown a link between the global SARS-CoV-2 pandemic and poor mental health, little is known about a possible association between hospitalization with SARS-CoV-2 infection and subsequent hospitalization for self-harm. Analyses performed on the French national hospital database between March 2020–March 2021 in 10,084,551 inpatients showed that hospitalization with SARS-CoV-2 infection was not associated with hospitalization for self-harm in the following year. However, hospitalization with SARS-CoV-2 was related to an increased risk of self-harm in patients with a suicidal episode at the inclusion (aHR=1.56 [1.14–2.15]), suggesting an effect of SARS-CoV-2 in patients with a recent history of self-harm.

1. Introduction

In addition to acute respiratory, digestive and systemic symptoms (Piroth et al., 2021), neurological symptoms are common with SARS-CoV-2 infection, underlining the pathogenicity of SARS-CoV-2 in terms of disruption of the central nervous system (Merad et al., 2022; Spudich et Nath 2022). Indeed, epidemiological evidence suggests that SARS-CoV-2 infection has a marked neuropsychiatric impact (Barthorpe and Rogers, 2022). Among the psychiatric issues that have emerged during this global pandemic (Winkler et al., 2021), suicidal behavior has been identified as one of its worst consequences (Nakanishi et al., 2022; Xiao et al., 2022). Moreover, many reports from around the world have pointed out the dramatic increase in self-harm and suicide, especially after the first waves and associated lockdowns in many countries, particularly in subgroups including youths and the elderly (Jollant et al., 2021; Wang et al., 2022; Jollant et al. 2022a; Dubé et al., 2021). Most

research has focused on the putative links between adverse psychological triggers (e.g. confinement, social isolation, or closure of non-essential activities) and self-harm behaviors in vulnerable populations (Farooq et al., 2021; Chauvet-Gelinier et al., 2022). In addition, a meta-analysis of studies conducted between 1910 and 2020, including the SARS-Cov-2 pandemic, showed that the link between historical epidemics and suicidal behavior did not appear to be strong, but also highlighted the lack of qualitative and quantitative data on the issue (Rogers et al., 2021; Zhu et al., 2022). Thus, it must be acknowledged that little is known about the possible direct effect of SARS-CoV-2 infection on suicidal behaviors that may occur in the months following admission to hospital with SARS-CoV-2. This prompted us to conduct a study using the French national hospital database in order to investigate a potential association between a hospitalization with SARS-CoV-2 in France from March 2020 to March 2021 and a hospitalization for self-harm in the subsequent 12-month period.

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2. Methods

2.1. Database

We conducted a retrospective analysis of prospectively collected data in a national cohort of all hospitalizations and identified factors associated with self-harm at one year in a vulnerable population, specifically SARS-CoV-2 patients, based on broad longitudinal cohort data (the national *Programme de Médicalisation des Systèmes d'Information* (PMSI) database). The PMSI includes discharge summaries for all inpatients admitted to all public and private hospitals in France (Goldberg et al., 2012), and was inspired by the American diagnosis-related group model. These national data are used for the allocation of hospital budgets, which encourages improvements in data quality in terms of coherence, accuracy and exhaustiveness. These hospital data have been used in medical research for many years (Goueslard et al., 2018; Jollant et al., 2022a,c), and their quality has been confirmed in recent studies on SARS-CoV-2 (Beltramo et al., 2021; Mariet et al., 2021).

2.2. Population

We included all patients aged 18 years or older, admitted to hospital between March 1, 2020, and March 31, 2021. We classified these patients into two groups:

- patients hospitalized with a diagnosis of SARS-CoV-2 in the inclusion period
- patients hospitalized without a diagnosis of SARS-CoV-2 in the inclusion period and in the follow-up period

Hospital stays for SARS-CoV-2 were identified by ICD-10 codes U07.10, U07.11, U07.12, U07.14, or U07.15 in the primary, related, or associated diagnoses.

Whatever the group (with or without SARS-CoV-2 diagnosis), the first stay identified during the inclusion period was considered the index hospitalization in order to count the patient only once.

2.3. Outcome and follow-up

The outcome was any hospitalization for self-harm identified with at least one ICD-10 code X60 to X84 filled in a hospital discharge abstract one year after the index hospitalization. Self-harm includes: poisoning (X60–69), hanging (X70), drowning (X71), firearm (X72–75), fire (X76–77), sharp/blunt objects (X78–79), jumping (X80), vehicle (X81–X82), other or unspecified (X83–84).

2.4. Variables studied

The following variables were assessed for all individuals included in the study. At baseline, we collected: age at index hospitalization, sex, admission to intensive care unit, somatic disorders according to the main category (all chapters of ICD-10) and psychiatric disorders (F10–F69 ICD-10 codes). Somatic and psychiatric disorders were defined as binary variables depending on the presence or absence of the condition. Age was taken into account in different ways. Firstly, we classified age into several categories (18–29, 30–39, 40–49, 50–59, 60–69, 70–79, 80–89, ≥ 90 years) by using disjunctive variables. Indeed, many papers have shown that the frequency of self-harm differed according to age group (Knipe et al., 2022), and we also found differences according to age group in our previous articles on self-harm and SARS-CoV-2 (Jollant et al., 2021; Jollant et al., 2022b). Secondly, we included age as a continuous variable with and without quadratic effect. Indeed, categorizing an essentially continuous variable may waste information (Altman and Royston, 2006; Royston et al., 2006) and can lead to implausible models.

We also considered a history of hospitalization for self-harm, somatic

disorders and psychiatric disorders in the 7 years preceding the index hospitalization. In particular, we considered the variable "Self-harm at inclusion or in the 7 previous years" with the following categories of self-harm: no history of self-harm, self-harm at inclusion, self-harm in the year prior to inclusion, between 1 and 2 years prior to inclusion and between 2 and 7 years prior to inclusion. Note that if a person had more than one event, we considered the most recent event.

Finally, two time periods were explored: March–September 2020 and October 2020–March 2021. These two periods correspond not only to the application of sanitary restrictions but also to the arrival of the Alpha variant in France at the end of the year 2020.

2.5. Statistical analyses

Individual characteristics, somatic and psychiatric disorders are presented as proportions, and comparisons between patients hospitalized with and without SARS-CoV-2 were made using a Chi² test. Age is presented as means \pm standard deviation (SD) and as medians and interquartile range, and comparisons were made using a Student's *t*-test or quantile regression.

To study the effect of hospitalization with SARS-CoV-2 on the risk of hospitalization for self-harm at one year (compared to patients hospitalized without SARS-CoV-2), we performed a survival analysis using Fine and Gray modeling. This model avoids a bias in the estimation of risk considering competing events such as in-hospital death. Indeed, this type of event may prevent the observation of the event of interest: self-harm. In this study, we considered all in-hospital deaths, regardless of cause. This model was adjusted for age, sex, admission to ICU, history of self-harm, somatic disorders and psychiatric disorders. A multiplicative Interaction (preferable to assess prediction or causal relationships (VanderWeele and Knol, 2014)) between SARS-CoV-2 and a self-harm at inclusion or in the 7 previous years was tested to determine whether there might be an excess risk in the high-risk population of patients with a history of self-harm. We also tested interactions between SARS-CoV-2 infection and the other variables (Table S1). These interactions were included in the models when they were significant.

The results are reported as adjusted hazard ratios (HR) and 95% confidence intervals (95%CI).

3. Results

We included 10,084,551 people hospitalized in France from March 1, 2020, to March 31, 2021; 402,954 were SARS-CoV-2 inpatients, i.e. 4.00% of the total study cohort (Table S2). The population of patients hospitalized with SARS-CoV-2 was significantly older (mean=68 years, median=71 years) than the control group of patients hospitalized without SARS-CoV-2 (mean=56 years, median= 58 years). There were significantly more men in the SARS-CoV-2 group (51.90%) than the control group (43.18%). There was no difference in previous hospitalization for somatic disorders between the two groups. Concerning our outcome, we identified 731 individuals with a hospitalization for self-harm during the 1-year follow-up in the SARS-CoV-2 group and 26,934 individuals in the control group (0.18% vs 0.28%). In the multivariable analysis, after adjustment for age, sex, admission to ICU, history of self-harm, somatic disorders and psychiatric disorders, we found that SARS-CoV-2 had no effect on the risk of hospitalization for self-harm. Regarding interactions, we found no significant interaction between SARS-CoV-2 and gender ($p = 0.33$) or ICU admission ($p = 0.08$) but with age ($p < 0.0001$), although there was no significant effect of SARS-CoV-2 on the risk of subsequent hospitalization for self-harm when looking at each age group separately. We also found a significant interaction between hospitalization with SARS-CoV-2 and a history of self-harm ($p = 0.0009$), which would be in favor of a more marked effect in SARS-CoV-2 patients with a history of self-harm. We then took into account the interaction between hospitalization for SARS-CoV-2 and the history of self-harm on the risk of new self-harm. The analysis

showed that among the patients who had committed self-harm at inclusion, those who were hospitalized for SARS-Cov-2 had a higher risk of a new hospitalization for self-harm within one year, compared to those hospitalized without SARS-Cov-2, whatever the model used (HR between 1.15 and 1.56, Table 1), and that this effect was significant when age was adjusted for as a continuous variable.

In addition, regardless of the model performed, we found that a history of psychiatric disorders was associated with a 6-fold greater risk of hospitalization for self-harm.

4. Discussion

Using a French national database, we revealed that hospitalization with SARS-CoV-2 infection was not associated with subsequent hospitalization for self-harm in the following year, except in people hospitalized for both SARS-CoV-2 and self-harm. These patients were significantly more at risk of repeated self-harm compared with patients hospitalized for self-harm but without SARS-CoV-2. On the one hand, our findings provide an argument for separating the psychobiological effect of SARS-CoV-2 infection from the psychosocial impact of the COVID-19 global pandemic in terms of suicidal outcomes (COVID-19 Mental Disorders Collaborators, 2021). The direct neuropsychiatric effects of SARS-CoV-2 infection might be a challenging issue, as confirmed by reports demonstrating that supposed psychosomatic sequelae appeared to have a weak association with previous SARS-CoV-2 infection (Matta et al., 2022). On the other hand, SARS-CoV-2 may cause detrimental neuropsychiatric events in individuals with pre-existing mental health problems (Yuan et al., 2022), e.g. people who have recently self-harmed, as suggested by our work. Recent studies have underscored that pre-infection psychological distress was associated with the risk of post-COVID-19 conditions and daily living impairments, suggesting the potential impact of psychiatric status on mental outcomes following SARS-CoV-2 infection (Wang et al., 2022).

This study had some limitations, mainly due to its design using a hospital database based on ICD-10 diagnosis codes. Clinical symptoms and some specific patient characteristics were not available in the PMSI database, which limits the scope of the analyses and the interpretation of results. For instance, long COVID evolution or substance use disorder

Table 1

Effect of SARS-Cov-2 on the risk of self-harm at one year according to the history of self-harm (multivariable Fine&Gray analysis in patients admitted to hospital between March 1, 2020, and March 31, 2021, 1st population).

	Model 1 : Age as a categorical variable HR [95% CI]	Model 2 : Age as a continuous variable HR [95% CI]	Model 3 : Age as a continuous variable (quadratic effect) HR [95% CI]
No history of self-harm	0.75 [0.55–1.03]	1.04 [0.76–1.43]	0.94 [0.68–1.30]
Self-harm at inclusion	1.15 [0.81–1.64]	1.56 [1.14–2.15]	1.44 [1.04–2.00]
self-harm in the year prior to inclusion	0.92 [0.59–1.42]	1.26 [0.83–1.92]	1.14 [0.74–1.74]
Self-harm between 1 and 2 years prior to inclusion	0.91 [0.61–1.34]	1.24 [0.84–1.81]	1.12 [0.76–1.66]
Self-harm between 2 and 7 years prior to inclusion	0.86 [0.59–1.24]	1.16 [0.82–1.64]	1.06 [0.75–1.51]

HR = Hazard ratio ; CI = Confidence interval; Adjusted on age, sex, intensive care unit admission at inclusion, somatic disorders at inclusion or in the 7 previous years, psychiatric disorders at inclusion or in the 7 previous years, period of the epidemic.

could not be included in the statistical analysis due to poor coding for these conditions in the French medico-administrative database. We also do not have access to data about out-of-hospital deaths which may induce a bias. We also cannot discount that a number of patients infected with SARS-CoV-2 were not hospitalized. Furthermore, it is possible that a large number of patients who self-harmed were not hospitalized, with some recent work suggesting that 40% of self-harm does not result in hospitalization in France (Jollant et al., 2022c,d). Additionally, other confounding factors such as the level of social stringency (social restrictions), infection (number of new cases and deaths and associated fear), and economic difficulties (either prior to or during the pandemic) could not be incorporated into our analyses.

Nevertheless, this nationwide exploration indicates that hospitalization for SARS-CoV-2, although not an independent risk factor for hospitalization for a subsequent self-harm in the general population, increases the risk of hospitalization for self-harm in people with a recent history of suicide attempt. Further research is needed to determine the effect on non-hospitalized self-harm and whether SARS-CoV-2 infection may facilitate the re-emergence of suicidal thoughts and behaviors in vulnerable individuals.

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Data availability

The use of these data by our department was approved by the National Committee for data protection. We are not allowed to transmit these data.

PMSI data are available for researchers who meet the criteria for access to these French confidential data (this access is submitted to the approval of the National Committee for data protection) from the national agency for the management of hospitalization (ATIH - Agence technique de l'information sur l'hospitalisation).

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Jean-Christophe Chauvet-Gelinier: Conceptualization, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jonathan Cottenet:** Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Matthieu Guillaume:** Validation. **Franck-Teddy Endomba:** Validation. **Fabrice Jollant:** Conceptualization, Validation, Writing – review & editing. **Catherine Quantin:** Conceptualization, Data curation, Methodology, Supervision, Validation, Writing – review & editing.

Declaration of Competing Interests

The authors have declared that no competing interests exist.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2023.115214](https://doi.org/10.1016/j.psychres.2023.115214).

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