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Suicide and quarantine during the COVID-19 pandemic: Do we know everything?

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ABSTRACT

Background: There is widespread concern over the impact of COVID-19 and lockdown measures on suicidal behaviour. We assessed their effects on suicide and hospitalization for attempted suicide during the initial phase of the pandemic in Chile.

Methods: We used panel data at the county and month level from January 1, 2016 to December 31, 2020 on suicides and related hospitalizations and a pandemic quarantine dataset. Poisson regression models and a difference-in-difference (DiD) methodology was used to estimate the impact of quarantine on both measures.

Findings: Suicide and hospitalizations for attempted suicide decreased (18% and 5.8%, respectively) during the COVID-19 outbreak in Chile (March–December 2020) compared to the same period in 2016–2019. The DiD analysis showed that there was at least a 13.2% reduction in suicides in quarantined counties relative to counties without such restrictions. This reduction was in male suicides and unaffected by age. There was no significant difference between quarantined and non-quarantined counties in terms of hospitalization for suicide attempts.

Conclusions: This study shows a significant quarantine effect on reducing suicide during the initial phase of the COVID-19 pandemic in Chile. Changes in the number of hospitalizations for suicide attempts do not explain the differences between quarantined and non-quarantined counties.

Credit author statement

FD and AJ-M were involved in the conceptualization and design of the study. FD was in charge of data curation and analysis. AJ-M wrote the first draft of the manuscript. Both authors approved the final manuscript.

1. Introduction

There is widespread concern over the impact of COVID-19 and lockdown measures on suicidal behaviour (John et al., 2021). Effects from the pandemic and measures taken to mitigate it have created concerns that suicide rates and self-harm may increase due to risk factors such as unemployment and economic uncertainty, increased social isolation and loneliness, lessened physical and mental health, and reduced access to community support or health services (John et al., 2021; Nordt et al., 2015; Gunnell et al., 2020; Cénat et al., 2021; Franklin et al., 2017). It has also been suggested that lockdown measures may have a detrimental effect on psychological well-being (Brooks et al., 2020). Quarantines could have negative consequences such as domestic violence, increased loneliness, financial and job insecurity, perceived loss of control, and a sense of entrapment (Brooks et al., 2020). These factors could increase the risk of self-harm and suicidal behaviour (Gunnell et al., 2020; Brooks et al., 2020), with a potential effect of overloading emergency and mental health services.

However, emerging international evidence suggests that during the early months of the COVID-19 outbreak, there was either no change or a reduction in suicides (Leske et al., 2021; Pirkis et al., 2021). A Peruvian

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nationwide time series analysis found that lockdown was associated with a sudden reduction in suicides (Calderon-Anyosa and Kaufman, 2021). In relation to non-fatal suicidal behaviour, a study conducted in the US found no evidence of increased suicidal thoughts or attempts among people living in states with stay-at-home orders or movement restrictions compared to states without these measures (Bryan et al., 2020). Likewise, studies conducted in the UK, Sri Lanka and Paris show a substantial decline in hospitalizations for suicidal behaviour in different age groups following the introduction of lockdown measures (Hawton et al., 2021; Knipe et al., 2021; Mourouvaye et al., 2021). It is unclear whether this reduction is due to a real decrease in self-harm or people avoiding hospitals during the pandemic (Hawton et al., 2021; Knipe et al., 2021; Mourouvaye et al., 2021).

Chile is an upper-middle-income country with relatively high prevalence of mental illness and low access to mental health services (Vicente et al., 2016). Official data show a significant increase in suicide rates between 2000 and 2010, followed by a slight decrease between 2011 and 2017 (Nahuelpan et al., 2018). For several months during 2020, Chile had a combination of high COVID-19 rates and mortality with prolonged quarantines. A nationwide longitudinal survey of adults shows that there was a significant increase in the prevalence of moderate to severe anxious and depressive symptoms between May and October 2020 (from 23% to 27%) (Duarte and Jiménez-Molina, 2022). This increase in psychological distress appears to be associated with pandemic conditions (Duarte and Jiménez-Molina, 2022) and could result in an increase in risk factors for suicidal behaviour.

In this study our goal is to determine the effects of lockdown measures on suicide and hospitalization for attempted suicide during the initial phase (March–December 2020) of the COVID-19 pandemic in Chile. To the extent that non-fatal suicidal behaviours have been less studied than suicide deaths in the context of the COVID-19 pandemic (John et al., 2021), we have considered hospital discharges for suicide attempts as a proxy for suicide attempts.

In the emerging pandemic literature, interrupted time-series analysis, and the difference-in-differences (DiD) method have been used to study trends in suicide rates (Leske et al., 2021; Pirkis et al., 2021; Tanaka and Okamoto, 2021). As our main objective is to compare quarantined and non-quarantined groups over time, the use of interrupted time-series analysis is not the best methodological alternative. Therefore, based on national data from both the pre-pandemic (2016–2019) and the pandemic periods (2020), we estimate the impact of quarantines on suicide and hospitalizations for attempted suicide using a DiD approach, a widely used method to infer the causal effects of specific policies and events from observational data.

The relevance of this study is related to the need to understand the indirect consequences of policies adopted to mitigate the spread of COVID-19. The evidence available so far is insufficient for understanding their impact on suicidal behaviour (John et al., 2021; Qi et al., 2021; Moser et al., 2020). Most studies that have attempted to address this association are qualitative (case reports and psychological autopsies), used very small samples, and evaluated short periods of time or small areas (John et al., 2021). Therefore, more research from different social contexts is needed. The results of this study could help to understand the association between pandemic conditions and suicidal behaviour.

2. Methods

We use administrative public mortality records from the Chilean Ministry of Health (https://deis.minsal.cl/, accessed on March 15, 2021). These data include all causes of death from January 1st, 2016 to December 31st, 2020. These records are anonymized and coded according to CIDI-10 criteria, and include date and cause of death, and some demographic characteristics such as age, gender, and region and county of residence. To correct for county population, we use the population database published by the National Institute of Statistics.

We also use administrative public records of hospital discharges (2016–2020) from the Chilean Ministry of Health. These records are anonymized and coded according to CIDI-10 criteria and contains the date and cause of hospitalization and some demographic characteristics, such as age, gender, and region and county of residence.

As primary measures we use suicide deaths and hospital discharges for suicide attempts.

Starting in mid-March 2020, the Chilean government introduced strict physical distancing and lockdown measures. To start with, they only used strict quarantines, where people's mobility was reduced as much as possible. A more flexible quarantine was introduced in August 2020. Thus, it is possible to differentiate two types of quarantine: (1) maximum reduced mobility during the entire week (phase 1), and (2) mobility reduced somewhat during weekdays, allowing the reopening of certain businesses (eg. restaurants), remaining completely reduced during weekends (phase 2). Quarantines are further differentiated by duration (from 1 to 4 weeks within a month), as well as by geographical location.

Quarantine data was obtained from the official gazettes published by the Chilean government (www.diariooficial.interior.gob.cl). Quarantine started in March 2020, with 7 counties affected out of a total of 344 (note this is 7.7% of the population). In June the quarantine increased to 55 counties, i.e., 49.6% of the population (in September 139 counties were quarantined, increasing to December with 143 counties).

2.1. Panel data

To obtain a balanced panel, the suicide and the hospitalization samples were combined with the quarantine sample at the county and month level, including those without any suicides. There were 20,760 observations at the county-month level for January 2016 to December 2020.

2.2. Data analysis

Since we want to understand the differences between quarantined and non-quarantined counties, we used a quasi-experimental research design (DiD), which is commonly used to study causal relationships in public health settings where randomized controlled trials are not feasible (Wing et al., 2018). The results of a before-and-after comparison could be due to different mortality trends or other unobserved confounding factors and is not suited to answer the question of differences across counties. DiD allows for the comparison between quarantined (treatment group) and non-quarantined counties (control group) before and after the implementation of quarantine. This type of analysis allowed us to isolate the effects of quarantines from local and seasonal suicide trends. In addition, we used Poisson models to account for the number of suicides or hospitalizations as the dependent variables. We use the county population as the exposure variable. A Poisson regression is used to model count data and assumes that the logarithm of the expected value of the dependent variable is a linear model.

2.3. Therefore, the main regression is

$$E(s_{cmy} \,/\, X) = \exp(\, \alpha d_c + \beta d_m + \gamma d_y + \delta DID_{cmy})$$

where, s_{cmy} is the number of suicides or hospitalizations per county (c), month (m), and year (y); d_c are dummies for counties, d_m are dummies for months; d_y are dummies for years; DID_{cmy} is a dummy that takes the value of 1 when county c in month m in year y is under quarantine and 0 if it is not (X are the independent variables mentioned). The coefficient of interest is δ. We carried out different specifications that are explained in the supplementary material (see supporting information). Additionally, we run a negative binomial allowing for overdispersion.

The regression has two treatment definitions: (1) the variable DID_{cmy}, is 1 for the county-month under quarantine and 0 otherwise (for

example, county x is under quarantine for June, but not for July, therefore the variable takes 1 and then 0); (2) as a more restrictive specification, we defined a new DID_{cmy} variable, which is 1 once a county is quarantined, maintaining that value until the end of the period.

Fig. 1 shows the distribution of treated or control counties throughout the country following the most restrictive specification.

Parallel trend and placebo tests. Following the current literature on DiD methodology (Tanaka and Okamoto, 2021; Wing et al., 2018), we conducted parallel trend tests (event study) and several placebo tests to check that the quarantine's impacts are not due to common time trends or common shocks in different periods or areas (more details in the supporting information, Tables A and B, Figs. A and B).

Heterogeneity. We separated the sample by different demographic groups to identify possible heterogeneous effects. We estimate the heterogeneity impacts across gender and age groups (children and adolescents <19 years-old, emerging adults between 19 and 29 years-old, adults 30-64 years-old, and older adults 65 years or older).

2.4. Ethical approval

Ethical approval was obtained from the Ethics Committee of the Faculty of Psychology of Diego Portales University.

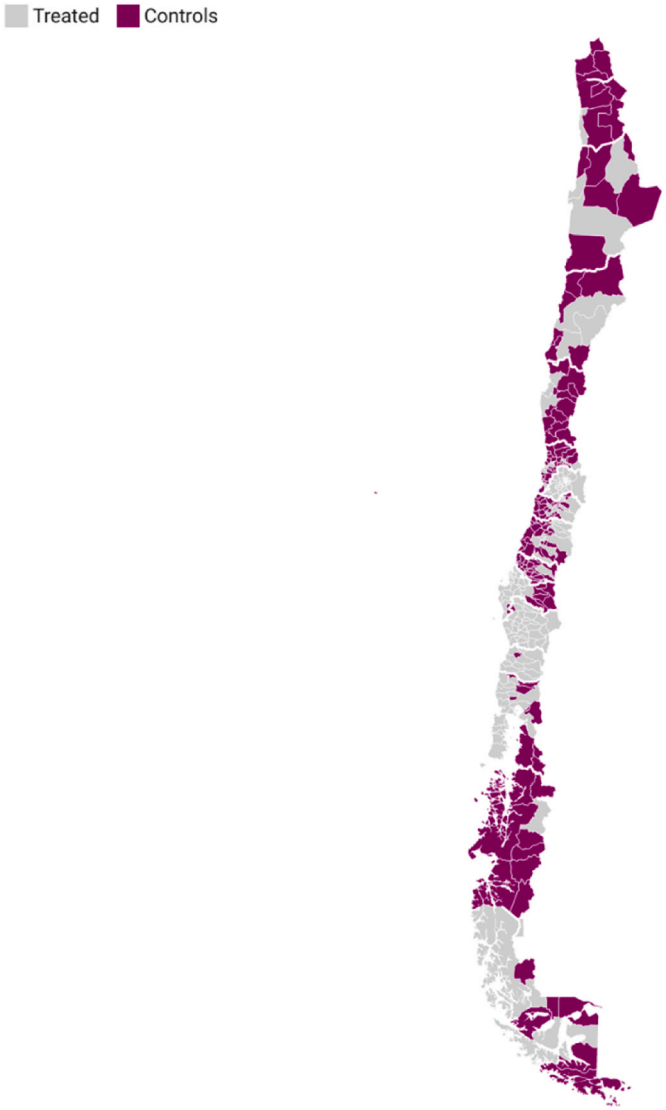

Fig. 1. Treated and control counties throughout the country.

3. Results

3.1. Suicide

The final sample of suicides has 9026 individual-level observations. The average age is 43.7 years, 82.57% are men, and 17.43% are women.

Suicides accounts for, on average, 1864 deaths yearly (10.01/100,000) between 2016 and 2019, 1.7% of total deaths. In 2020, suicides dropped to 1571 (8.07/100,000), a 15.7% reduction (and a 19.3% drop in the rate per 100,000). This is 0.4489 average suicides per county per month for 2016 to 2019, and 0.3784 suicides for 2020. Fig. 2 shows the number of suicides per year and average per month during the period 2016–2020.

If we compare the data between March (due to it being the pandemic onset in Chile) and December of each year, the results are similar. The average number of deaths by suicide between March and December 2016–2019 is 1,527, while for 2020 this number is 1251 suicides, representing a reduction of 18%. Fig. 3 shows that during most of the pandemic months, there were fewer suicides than in previous comparable periods.

Table 1 shows that counties quarantined at some point during 2020 (treatment group) have a 20.8% decrease in the number of suicide deaths during March–December 2020 compared to the same period in 2019. In contrast, never quarantined counties (control group) had a smaller decrease in suicides (17.5%).

As mentioned before, the DiD model assigned a treatment condition when a county was quarantined. This regression model uses aggregated data at the county and month-year level. Alongside this we ran the regression using a Poisson model that accounts for the dependent variable, number of suicides per county-month. We control by county population, month, and year fixed effects.

Table 2 shows the results of the main regression for the two treatment definitions. Using the first definition (quarantine), there is a 14.3% decrease in suicides in quarantined relative to non-quarantined counties. Likewise, when we use the second definition (always quarantine), there is a 13.2% relative decrease in quarantined counties. The 3.3pp (or almost 20%) difference in the decline between quarantined and non-quarantine counties (16% vs. 14.5%) is consistent with the Poisson regression results (this result can be seen plotted as a map in the supplementary information, Figure C). In the following we use the most restrictive definition (always quarantine) because it is the most conservative estimation. As a robustness check, we additionally use a negative binomial that allows for overdispersion and find the same results.

In the quarantined counties (186) there was an average of 0.693 suicides per month during 2016–2019, while in the control group (160) there were 0.165 suicides per month per county. By using the control group rate for the treatment group, we predict 1322.5 suicides in 2020, versus our finding of 1290.2. This is 29.6 fewer suicides yearly due to the quarantine, i.e. a 1.59% decrease.

3.2. Suicide by age and gender

Heterogeneity analyses show that there was a significant quarantine effect on male suicides but not female ones (Table 3). For men, there was 14.6% comparative decrease in quarantined counties. There are not any significant effects by age (Table 4).

4. Hospitalization for attempted suicide

We also analysed the changes in hospitalizations for suicide attempt. The final sample of hospital discharges has 18,783 individual-level observations. The average age is 29.77 years, 29.46% are men, and 70.54% are women.

We find that the average number of hospital discharges for suicide attempts between March and December 2016–2019 was 2645; while in

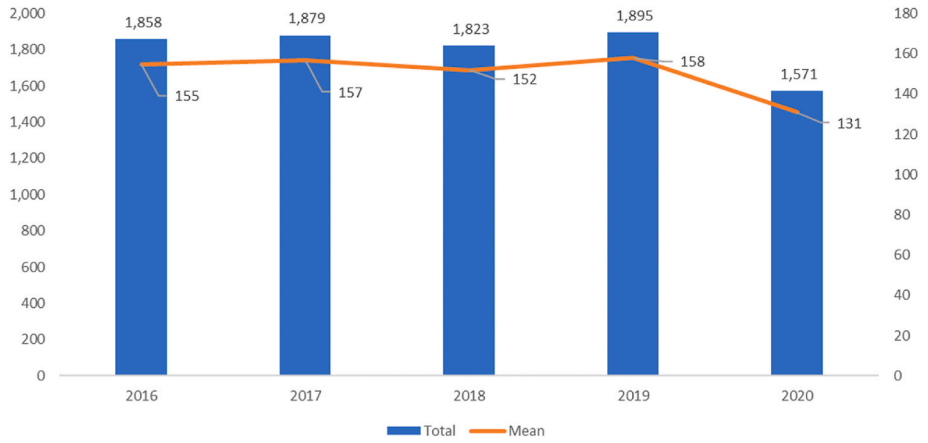

Fig. 2. Number of suicides per year/monthly average (2016–2020).

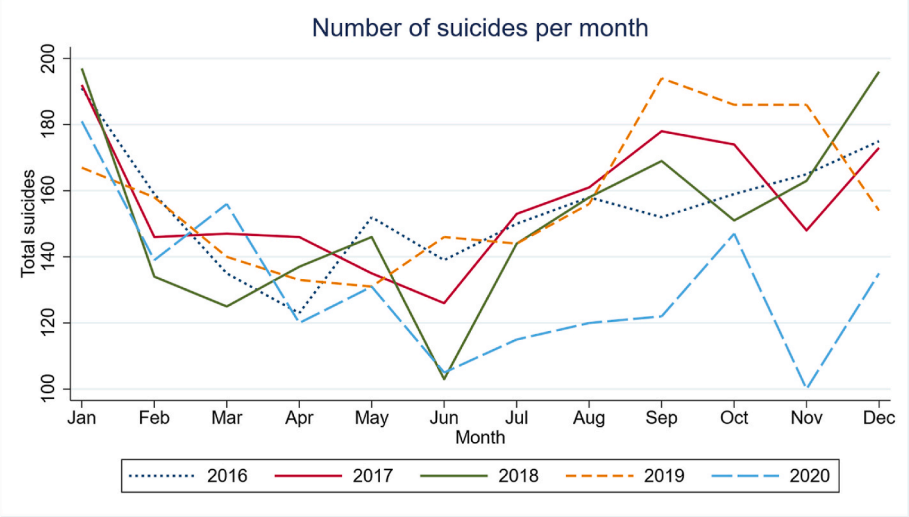

Fig. 3. Number of suicides per month (2016–2020).

Table 1
Number of suicides in control and treatment groups per year (March–December 2016–2020).

Year	Control	Treatment
2016	237	1271
2017	271	1270
2018	268	1224
2019	257	1313
2020	212	1039

Note: Based on the original database of suicides.

2020 discharges dropped to 2491 in the same period of months, a 5.8% drop. In 2020 we found a break from previous years' trends as shown in Fig. 4.

If we look at hospital discharges by month and year, it does not have a pattern like that of suicides during the pandemic period (Fig. 5).

Moreover, as can be seen in Table 5, the treatment group has a 15.7% decrease in the number of hospitalizations during March–December 2020 compared to March–December 2019, but the control group has an even higher decrease (20.4%) in the same period.

We then analysed the differences between hospital discharges using the same DiD methodology. Both county groups have a decrease but no significant differences between them (Table 6). There were also no differences in terms of gender or age between control and treatment

Table 2
Poisson regression at county and month level (Incidence ratio).

	Number of Suicides	Number of Suicides
Quarantine	0.857**	
Std. Errors	(0.0540)	
P-value	0.015	
CI 95%	[0.757–0.970]	
Always quarantine		0.868**
Std. Errors		(0.0589)
P-value		0.037
CI 95%		[0.759–0.991]
Observations	20,760	20,760
County FE	YES	YES
Year and month FE	YES	YES

Note: FE = Fixed Effects, i.e., a dummy variable for each county and each period. Cluster at county level.
***p < 0.01, **p < 0.05, *p < 0.1.

counties (see supporting information, Tables C and D).

4.1. Placebo and parallel trend test

Following the DiD strategy (Wing et al., 2018), we show in the study

Table 3
Poisson regression at county and month, by gender (Incidence ratio).

	Female Number of Suicides	Male Number of Suicides
Always quarantine	0.921	0.854**
Std. Errors	(0.159)	(0.0653)
P-value	0.633	0.039
CI 95%	[0.656–1.291]	[0.735–0.992]
Observations	83,004	82,956
County FE	YES	YES
Year and month FE	YES	YES

Note: FE = Fixed Effects, i.e., a dummy variable for each county and each period. Cluster at county level.
***p < 0.01, **p < 0.05, *p < 0.1.

events that there is a parallel trend in the main specifications, and placebo test analysis suggests that our results are not driven by a spurious correlation, validating the relationship between quarantine and suicides. In the supporting information, we present robustness checks.

5. Discussion

To the best of our knowledge, this is the first DiD analysis of suicide and hospitalizations for attempted suicide during the COVID-19 pandemic in Latin America. We found a decrease in the number of suicides and a slight decrease in related hospitalizations during the initial phase (March–December 2020) of the pandemic compared to the 2016–2019 period. These findings are consistent with the international emerging evidence available for high- and upper-middle-income countries (Pirkis et al., 2021; Hawton et al., 2021).

There may be several factors playing a role here. First, pandemics are similar to community-wide disasters, which have been associated with decreased suicide rates (Zortea et al., 2020). The shared crisis experience may lead people to support each other, thereby strengthening social bonds (Zortea et al., 2020; Wasserman et al., 2020). Second, the Chilean government responded quickly prioritizing emergency responses to suicide (suicide hotline) and implementing an online platform to deliver psychosocial support to people with mental health problems. Third, to alleviate rising unemployment and the economic impact, the government created a cash transfer program targeting the most affected households. Additionally, the National Congress passed a law allowing workers to withdraw up to 10% of their pension fund. As previous studies suggest, access to these financial subsidies may have reduced suicides (McIntyre and Lee, 2020).

There was at least a 13.2% reduction in suicides in quarantined counties relative to non-quarantined ones. The mechanisms behind this are not clear. Problems related to "stay-at-home" orders such as isolation, disruption of normal routine, and feeling trapped could increase suicide risk (Brooks et al., 2020; Hawton et al., 2021). However, in some households, quarantine conditions increased time spent with others, strengthening family relationships (Evans et al., 2020). Main protective factors against suicide include family support and bonding with significant others (O'Connor and Nock, 2014).

The ideation-to-action framework proposes that the passage from ideation to suicide attempt can be conceived as distinct processes with separate predictors and explanations (Klonsky et al., 2016). Suicidal crises are often ambivalent, and the suicide decision simultaneously involves multiple factors that either persuade or dissuade an individual from an attempt (Martínez et al., 2014). From this perspective, quarantine conditions could be a contextual deterrent to suicide. For example, suicidal behaviour may be deterred by the consequences it might have on other people in the household (Martínez et al., 2014).

Table 4
Poisson regression at county and month, by age group (Incidence ratio).

	0-18 Number of Suicides	19–29 Number of Suicides	30–64 Number of Suicides	65+Number of Suicides
Always quarantine	0.573	0.848	0.905	0.867
Std. Errors	(0.234)	(0.120)	(0.0807)	(0.147)
P-value	0.172	0.244	0.262	0.398
CI 95%	[0.257–1.257]	[0.641–1.119]	[0.759–1.077]	[0.622–1.207]
Observations	41,496	41,520	41,520	41,424
County FE	YES	YES	YES	YES
Year and month FE	YES	YES	YES	YES

Note: FE = Fixed Effects, i.e., a dummy variable for each county and each period. Cluster at county level.
***p < 0.01, **p < 0.05, *p < 0.1.

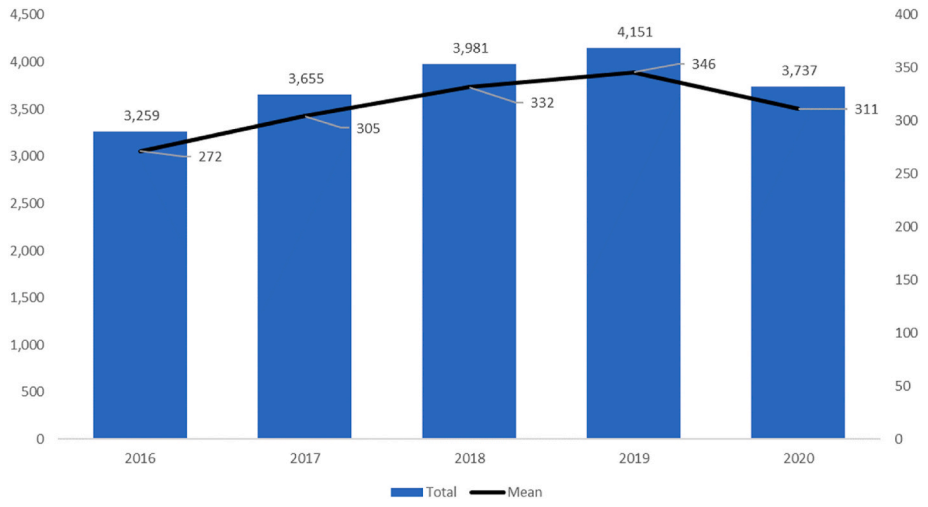

Fig. 4. Number of hospitalizations per year/monthly average (2016–2020).

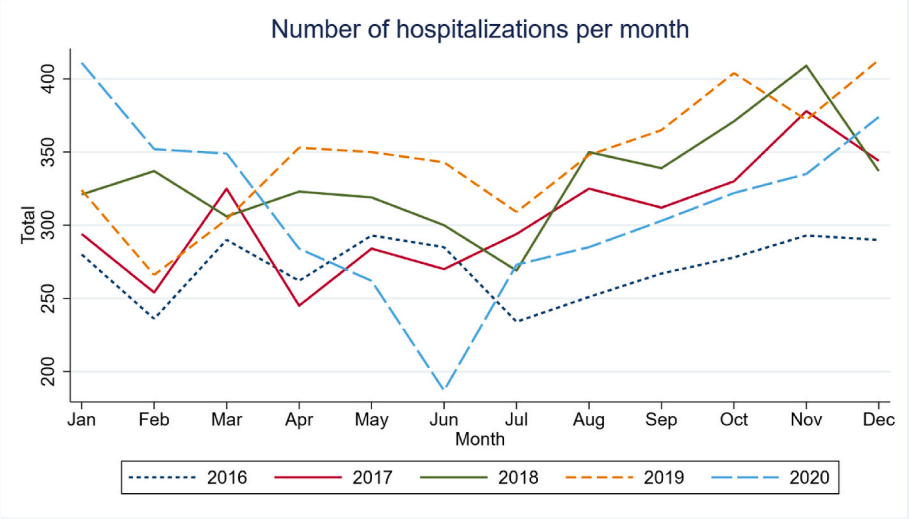

Fig. 5. Number of hospitalizations per month (2016–2020).

Table 5
Number of hospitalizations due to non-fatal suicidal behaviour for control and treatment groups per year (March–December).

Year	Control	Treatment
2016	474	2269
2017	542	2565
2018	528	2795
2019	607	2954
2020	483	2491

Note: Based on the original database of hospitalizations.

Table 6
Poisson regression at county and month level (Incidence ratio).

	Number of Hospitalizations	Number of Hospitalizations
Quarantine	1.014	
Std. Errors	(0.0609)	
P-value	0.82	
CI 95%	[0.901–1.14]	
Always quarantine		1.050
Std. Errors		(0.0685)
P-value		0.457
CI 95%		[0.923–1.19]
Observations	20,760	20,760
County FE	YES	YES
Year and month FE	YES	YES

Note: FE = Fixed Effects, i.e., a dummy variable for each county and each period. Cluster at county level.
***p < 0.01, **p < 0.05, *p < 0.1.

Likewise, during quarantine, individuals may have less privacy, decreasing opportunities for self-harm. In other words, this situation may be reflecting the greater proximity of household members during quarantine and greater attention to the warning signs of suicide. Restricting access to lethal suicidal means and support from family members or loved ones are key interventions for suicide prevention (Wasserman et al., 2020). In addition, the lockdowns appear to have reduced access to and opportunities for alcohol and drug use (ServicioNacionalde Alcohol and (SENDA), 2020), which are an important risk factor for suicidal behaviour.

From a theoretical perspective, the association between quarantine and suicide can be explained by the integrated motivational-volitional model of suicidal behaviour, which stresses the importance of motivational moderators such as perceived burdensomeness, thwarted belongingness, and low social support (O'Connor and Nock, 2014). It is possible that changes in household dynamics and lifestyle during lockdowns have affected these dimensions, especially in people living with others. For example, maintaining regular contact with others may increase the feeling of belonging and social connection.

This may be reinforced by the impact of quarantine on the movements of people living in the household. During the pre-pandemic period (2011–2017), many suicides (~30%) occurred during weekends, especially when people were home alone (Nahuelpan et al., 2018). Our results show that people living in quarantined counties are less likely to commit suicide over the weekend, suggesting that the decrease may be due to the increased presence of others.

There is also differential impact by demographics. While men continue to account for the largest number of suicides during the pandemic (81.9%), we find a significant quarantine effect for men, but not women. Some of the possible explanations for gender differences include emotional disparities, coping strategies, and differences in method of suicide, as well as biological and social factors (Richardson et al., 2021). Women are more likely to use non-violent methods such as drugs, while men make more impulsive, less planned attempts, and choose more lethal methods (Richardson et al., 2021). Future research is needed to explore the link between these factors and quarantine conditions, and to improve our understanding of who exactly was being affected and how.

Furthermore, we found a slight decrease in hospitalizations for suicide attempts compared to the pre-pandemic period. This is a much smaller reduction than those found in other countries (Hawton et al., 2021; Knipe et al., 2021; Mourouvaye et al., 2021), and it is important to emphasize that this finding may reflect changes in hospital use due to COVID-19 rather than a reduction in self-harm. We also did not find any significant differences between control and treatment counties in terms of number of hospitalizations, and there was no statistical evidence that this differed by age or gender. This seems to reinforce the fact that suicide and attempted suicide should be conceived as discontinuous phenomena with separate predictors and explanations (Klonsky et al., 2016).

Overall, this study addresses the effects of lockdown measures on suicide. Further research is extremely important because the long-term impact of the current pandemic on suicidality remains uncertain. A systematic review suggests that although suicide rates might increase following pandemics, the changes might not necessarily occur immediately (Zortea et al., 2020). For example, a study in Japan shows that a decrease in suicides at the beginning of the COVID-19 pandemic was

followed by an increase from the second half of 2020 (Tanaka and Okamoto, 2021). The impact of the pandemic's adverse effects may vary depending on the local differences including the capacity of existing mental health services, the existence of national suicide prevention programs, and the economic mitigation measures.

5.1. Strengths and limitations

One of the main strengths of this study is that it is based on national data covering both the pre-pandemic and pandemic periods. The other strength is the type of data analysis (DiD), as it allows for comparison of quarantine effects in relation to possible counterfactuals.

However, this study has methodological limitations that should be considered. One possible limitation is that data from some areas of the country may have been less reliable and more prone to under reporting due to pandemic interference. Research on the effects of the pandemic requires more accurate and fine-grained data to inform timely public policy decision-making (Carballada and Balsa-Barreiro, 2021). In the case of research on suicidal behaviour, this urgently requires agreeing on criteria for accessing health data containing sensitive information and addressing issues related to privacy and data aggregation.

Second, this study does not allow us to determine whether the decline in hospitalizations for suicide attempts reflects reduced access to treatment or a true decline in the incidence of self-harm. Third, the small numbers of suicides in some areas might have relatively poorer power and precision. Fourth, assuming that quarantine measures are driven by increased morbidity and mortality in each county, and that these phenomena could represent risk factors for suicidal behaviour, our estimates should be interpreted as the lower bound of the actual estimates.

6. Conclusion

During the initial phase of the COVID-19 pandemic in Chile (March–December 2020) there was a decrease in the number of suicides and a slight decrease in hospitalization due to suicide attempts. The results suggest that the reduction in suicide was affected by lockdown measures, especially for men. However, changes in hospitalizations were not related to the quarantine conditions. This may suggest that the changes in the number of hospitalizations for suicide attempts do not explain the differences between quarantined and non-quarantined counties.

This study provides evidence on external factors that may influence suicide patterns during a pandemic. These findings are consistent with those from other countries but should not be used as a prediction of the pandemic's long-term impacts on suicide and self-harm. It remains important to monitor suicide and self-injurious behaviours, to develop preventive initiatives, and to increase availability to and encourage the use of mental health care.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2022.115253.

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