Effects of 2019's social protests on emergency health services utilization and case severity in Santiago, Chile

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Abstract

Background: On October 18th, 2019, protestors gathered across Chile to call for social equity, resulting in widespread civil unrest and violent confrontation with the police. In this study we quantify the effects of the 2019 Chilean protests on emergency health services utilization and inpatient admission in Santiago.

Methods: We used weekly emergency department (ED) admissions (2015-2019) from three large public hospitals near the focal point of protests in Santiago. The exposure period was from October 18th to December 31st, 2019. The outcome were the number of weekly consultations and hospitalizations by trauma and respiratory causes and the proportion of hospitalizations among consultants per 1,000. We implemented Bayesian structural time series models to calculate the absolute and relative effects and their 95% credible intervals (CrI).

Findings: ED consultations declined by 14% for trauma (95% Credible Intervals [CrI]: -40·2%, 11·5%) and 30% for respiratory causes (95%CrI: -89·4%, 30·2%) during the first ten weeks of protests. Trauma hospitalizations increased by 15% (95%CrI: 4·0%, 26·4%), and the proportion of hospitalizations per consultations increased by 40% for trauma (95%CrI: 13·1%, 68·0%) and 59% for respiratory causes (95%CrI: 29·4%, 87·9%).

Interpretation: The 2019 Chilean protests affected the use of emergency health services by lowering the number of consultations due to trauma and respiratory causes, while increasing the rate of hospitalizations among consulting patients. Crowd-control protocols must be reviewed to prevent negative effects of civil unrest on population health.

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Introduction

Throughout history, the world has continually witnessed social movements and civil unrest on the local, national, and global levels.[1] Social movements are defined as organized efforts by a group (or groups) of people working toward a common goal. During a movement, participants may intentionally cause a public disturbance that violates the law, an act known as civil unrest; non-authorized peaceful protests may also receive violent police responses, also resulting in unrests.[2] In Chile, in October of 2019, a metro fare increase of 30 pesos (about USD 0·04) triggered protests that quickly began to encompass concerns stemming from historical injustices and social inequality. Protestors called for structural changes related to wealth distribution, rising costs of living, stagnant wages, access to and quality of basic public services (e.g., health, education, transport, and justice systems), and retirement pensions, among other structural processes. Despite a lack of organized leadership, this social movement featured high attendance rates and strong national support. However, civil unrest occurred collaterally with the social protests, which led the government to declare a state of emergency characterized by restricted mobility, a curfew, and the deployment of armed soldiers and policemen to control street disturbances.[3]–

Much of the current research linking social movements and health has focused on the indirect effects of protests, demonstrations, and civil unrest. For instance, civil unrest and violence often expose people to stress, contributing to mental health burdens.[4] Similarly, the shutdown of city streets, disruption of public transportation, and damage to public and private infrastructure may affect health services utilization by restricting patient access.[5,6] Emergency department (ED) consultations are heavily influenced by barriers to access and serve as a measure of health services utilization.[7–9]

Other mechanisms likely influence ED visits during civil unrest as well. Crowd control techniques such as pellet guns, tear gas, and other chemical irritants have been shown to have adverse effects

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on individual health, and the way these are used can impact the overall rate of ED consultations.[10] Rubber bullets have been cited for causing eye injuries, lacerations, contusions, and hematoma. Burns and physical blows from batons, bottles, bricks, boots, and other objects also account for physical injury during protests.[9–12] The use of tear gases —a subset of riot control agents that cause tears, eye pain, and difficulty keeping the eyes open— has been associated with short and long-term effects on the respiratory system.[9,11,13] Thus, the more immediate and direct exposure consequences of crowd control techniques are dermatological (e.g., irritation, dermatitis, skin rashes), traumatological (injuries and disabilities), and respiratory (e.g., dyspnea, coughing, choking, and chest tightness).[14]

Despite the known burden on individual health and well-being, evidence regarding the effects of social movements on population health is still lacking and continuously evolving. Some studies have reported the number and patterns of injuries and deaths during periods of civil unrest,[15–19] however, most of them are descriptive and do not consider identification strategies to generate causal conclusions about the impact of social movements on health.

In this study, we aimed to quantify the effects of the so-called "October 2019" Chilean protests on emergency health system services utilization and inpatient admission rates by trauma and respiratory causes.

Methods

Design

We used an interrupted time series analysis of aggregated weekly hospital ED admissions. The total daily emergency admission data of three major public hospitals in Santiago were gathered from 2015 to 2019 for both consultations and hospitalizations and aggregated into a weekly sum, according to ISO-8601. Two incomplete weeks were discarded: the first week of 2015 (from Thursday, January 1st, to Sunday, January 4th) and the last two days of 2020 (Monday, December

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30th and Tuesday December 31st). The data were then refined to isolate cases from ages 15 - 64, as most protesters were within this age range,[10] and cases were categorized according to their primary cause of admission.

Chile's capital, Santiago, was one of the areas most affected by the social protests in 2019, particularly around the historic focal point of social protest known as "Plaza Baquedano", "Plaza Italia", and more recently, "Plaza Dignidad". We included cases from tertiary public hospitals located within 3 kilometers of this focal point (Hospital de Urgencia Asistencia Pública, Hospital del Salvador de Santiago, and Complejo Hospitalario San José). Two of these hospitals are within 1 kilometer of the "Plaza". The ED's from the included hospitals are reference centers in the city, being among the largest hospitals in the region with about 2 million of the assigned adult population. The Hospital de Urgencia Asistencia Pública is a national referent center for severe trauma and burns.

Data acquisition

The data was obtained through the Chilean Department of Health Information and Statistics, which collects daily ED consultation and hospitalization data from public health centers. Information from ED medical forms is used to obtain the consultation date, patients' age, ICD-10 diagnosis at ED discharge, and hospital admission status. Data were deidentified and tabulated by each center and reported to the Ministry of Health, which then published the datasets containing the aggregated counts by cause (trauma, respiratory, circulatory system) and center. The dataset was publicly available on the internet (http://www.deis.cl); thus, no IRB approval was necessary to conduct and publish this work.

Variables

Outcome. Health services utilization was measured as the weekly counts of ED consultations and hospitalizations for trauma and respiratory causes. We also looked at the rates of hospitalizations for each cause among those consulting for that cause per 1,000.

Exposure. We defined the exposure period as the onset of social protests from October 18th to December 29th, 2019. This period consisted of most of the protests' milestones (see Supplemental Table 1 with a timeline of these milestones). Although protests continued during January and February (typically summer vacation months in Chile), they were far less in number and intensity than in previous months and the first two weeks of March, before the Covid-19 pandemic started in Chile. Due to the format of the data, we set the exposure period from October 21, 2019 (week number 43, according to ISO-8601). The pre-exposure period was from January 2015 to October 20, 2019.

Analysis

To evaluate the effect of social protests on ED service utilization, we used Bayesian structural time series (BSTS) models implemented through the *CausalImpact* R package in R v4·0·2.[20] This approach compares the observed trend of consultations and hospitalizations after the exposure, with an estimated average trend under the hypothetical scenario in which social protests did not occur (i.e., the counterfactual). The estimated effect is then the difference between the counterfactual and the observed number of consultations and hospitalizations following the social protest that started in October 2019.

This method allows for flexibility in the inference of counterfactuals, temporal evolution, and incremental attributable impact. Its estimations were achieved by incorporating features such as level, trends, seasonality, and regression to capture the time-series dynamics. We predefined additive monthly and yearly seasonal components. After estimating several models with different specifications, we selected those with lower cumulative absolute one-step ahead errors. The

selected models assumed a studentized distributed noise, which was robust against outliers and shocks, and included a random-walk that does not rely on an observable pattern or trend drift and has the advantage that it adapts to local variation. Such an approach was preferable for short-term predictions.[20]

The point effects of social protest and their 95% credible intervals (CrI) were generated as the differences between the estimated forecasts and the observed trends across each 40,000 Markov Chain Monte Carlo iterations, following a 10% burn-in period. The tail-area probability can be interpreted as the probability —across model iterations— of observing a response at least as extreme as the observed point estimate.[20] Additional details on the modeling approach and statistics are described in the Supplemental Material.

Finally, we performed a sensitivity analysis through a traditional difference-in-differences model using historical controls from 2015 to 2018, expressing the observed trend for each outcome in the same three hospitals but in years in which social protest did not occur. The difference-in-differences model included year fixed-effects and a dummy variable for each month to capture seasonal variations in outcomes.[21] Inferences were computed with robust standard errors to account for heteroscedasticity and autocorrelation.

Data and markdown with all software codes and outputs are available in https://bit.ly/3k1AUzj.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, writing of the report, or the decision to submit for publication.

Results

A total of 28,155 ED consultations with 3,022 hospital admissions for ages 15 - 64 were registered in the exposure period (10 weeks following the start of the exposure period, from October 21st to December 29th of 2019) in the three hospitals under study. Median weekly total consultations and

hospitalizations during the entire pre-exposure period (January 2015, to October 2019) were 3,132 and 288, respectively (Table 1), while during the protests were 2,854 and 298. Overall, during 2015-2019, trauma cases represent 26% of total consultations and 21% of total hospitalizations, and respiratory cases represent 5% and 7%, respectively.

The weekly number of consultations and hospitalizations by trauma and respiratory causes are shown in Supplemental Figure 1. The number of respiratory ED consultations and hospitalizations show a clear seasonal pattern with a large increase in the winter months, although the relative severity of cases does not appear to present with a seasonal variation. The number of trauma ED consultations and hospitalizations were higher than respiratory cases, with hospitalizations demonstrating fairly large variations throughout the time-series.

The relative differences between model predictions and the observed data in the 10-weeks pre and post protests are graphed in Figure 1. Overall, model predictions fit the observed pre-exposure data for all outcomes (Supplemental Figure 1 and Figure 1). The cumulative differences between the predicted and the observed trend are shown in Figure 2. ED consultations declined on average by 14% for trauma (95%CrI: -40·2%, 11·5%) and 30% for respiratory causes (95%CrI: -89·4%, 30·2%), while respiratory hospitalizations declined by 6.8% (95%CrI: -43.6%, 30.8%). However, none of these three results were statistically distinguishable from the null in the Bayesian time series model. Nonetheless, the absolute number of trauma hospitalizations, as well as the relative severity of consultations (rate of hospitalizations per 1000 consultations), increased following the social protests. The number of trauma hospitalizations increased in average by 15% (95% CrI: 4·0, 26·4), while hospitalizations per 1,000 consultations increased by 40% for trauma (95% CrI: 13·1, 68.0) and by 59% (95% CrI: 29·4, 87·9) for respiratory causes (Table 2).

Sensitivity analysis with a frequentist "differences-in-differences" model showed consistent results in terms of both direction and magnitude of the effects, although confidence intervals were

narrower. Social protests were associated with a 15·4% (95% CI: -24·2, -6·6) decline in trauma consultations and a 41% decline in respiratory consultations (95% CI: -69·7, -12·7). As with the Bayesian time-series approach, both trauma and respiratory hospitalizations per consultations showed increases in the magnitude of 26% (95% CI: 17·2, 35·3) and 47% (95% CI: 33·8, 59·3), respectively, as well as trauma hospitalizations, which experienced an increase of 12% (95% CI: 1·6, 21·6) (Supplemental Table 3).

Discussion

In this study, we aimed to quantify the effects of social protest and widespread crowd-control techniques on health service utilization within the Chilean context. Our findings suggest that, following the onset of the Chilean social movement on October 18, 2019, there was a decrease in consultations to ED services near the protest's focal point. However, the severity of trauma and respiratory cases increased, particularly when we looked at the proportion of hospitalizations per 1,000 trauma/respiratory ED consultations. Hospitalizations among consultations for trauma were 40% higher than expected, while, for respiratory conditions, hospitalizations were 59% higher. These results provide novel insights on the impact of social movements and violence during civil unrest on health service utilization and population health.

The overall decline in ED consultations could likely be explained through access; during this period, individuals with non-severe or life-threatening emergencies who would generally visit emergency services might reasonably avoid these hospitals.[5] In fact, public transportation was significantly disrupted throughout the time of the protests, particularly in the area surrounding the protest's focal point. It is also known that incident cases due to police confrontations and exposure to crowd-control methods, particularly those with minor and mild injuries, were treated on-site by volunteering health professionals, possibly lessening the ED burden from mild or non-life-threatening problems.[3]

The increase in the number and proportion of trauma hospitalizations during the social protest period suggests that confrontations and widespread use of crowd-control methods by law enforcement resulted in an increased number of civilians severely injured that needed medical attention. This is consistent with a previous study that evidenced an increase in severe ocular trauma by kinetic impact projectiles during this period,[10] as well as another study that demonstrated increased levels of trauma at the beginning of the social crisis in the south-east area of Santiago (fairly far from the protests' focal point), though the authors found no unambiguous differences compared with 2018.[22] It is also possible that due to access problems, patients with trauma or respiratory diseases could have delayed their ED consultations during this period, worsening the disease severity at ED presentation.

During the "October 2019" protests, many human rights organizations were present in Chile. The evidence contained in reports from the United Nations, The Interamerican Commission of Human Rights, The National Institute of Human Rights, Amnesty International, and Human Rights Watch, all agree in a disproportionated use of force by the police and soldiers, resulting in many cases in severe injuries and deaths among civilians.[23,24] The same reports state that policemen fired at short-distance and to the head of protesters—despite national and international protocols—with kinetic weapons or tear gas canisters. In fact, the world's largest number of ocular trauma by kinetic impact projectiles was documented in Chile during this period,[10] which is consistent with the increase in ED case severity illustrated by our results.

Social movements resulting in civil unrest are far from being merely a Chilean or even Latin American issue. Recent demonstrations have occurred for different reasons in countries such as France, Hong Kong, Syria, and the United States. As in Chile, many of these protests resulted in the widespread use of anti-riot shotguns and tear gas as a means of crowd control. The medical and public health community have raised concerns about the indiscriminate use of these methods and

the potential harm to those involved in the confrontation and surrounding areas.[6,25–28] These concerns may only increase in the future, as many authors have suggested that social movements are expected to increase in the near future due to the economic crisis derived from COVID-19.[29]

Implications

The results of this study should be seen as a first step in better understanding the broader health effects of large-scale social movements. We believe that our rigorous analytical approach may help to anticipate changes in ED consultation and hospitalization patterns as well as disruptions in healthcare access during periods of widespread violence in order to allocate efforts and resources accordingly. Second, and most importantly, we hope this study will be used to advise and advocate for policy change regarding police responses to civil unrest to prevent the escalation of violence and harm among protesters, the police force, and bystanders in surrounding areas.

Limitations

The results of this study should be seen in the light of the following limitations. The first and perhaps most crucial limitation was the difficulty obtaining hospital data from private institutions near the focal point of the protests. Although around 75% of the Chilean population have public health insurance[30] and likely use the public health system, there was a still fraction of the population that was not included in our study, which limits the generalizability of our findings. In addition, the degree of detail for emergency data in Chile is far from ideal. We were only able to use the grouped primary cause of admission; thus, contributory causes were not explored in the study. Finally, the precision of our main results was fairly poor, limiting our possibilities to generate robust conclusions on effect estimates for trauma and respiratory consultations. This is largely because the Bayesian structural time-series model is a fairly conservative approach due to its flexibility. However, the most consistent results using a more traditional difference-in-difference model give us confidence in our interpretation and final conclusions.

Conclusions

The October 2019 Chilean protests appear to affect emergency health system services by lowering the number of consultations due to trauma and respiratory causes, while simultaneously increasing the proportion of hospitalizations among admitted patients. It is necessary to implement policy changes regarding law enforcement actions and crowd control measures during civil unrest in order to limit adverse effects on population health.

Contributors

AIJG: Conceptualization, Data Curation, Writing the Original Draft. TDW: Formal analysis, Data Curation, Review & Editing. KDH: Formal analysis, Data Curation, Review & Editing. AGSC: Software, Formal analysis, Visualization, Review & Editing. JSK: Methodology, Visualization, Visualization, Review & Editing. ACC: Conceptualization, Methodology, Supervision, Visualization, Funding acquisition, Review & Editing.

Declaration of interests

We declare no competing interests.

Data sharing

This study was consucted using publicly available data from the Departamente of Statistics and Health Information at the Chilean Ministry of Health. Data availability and markdown with all software codes and outputs are available in https://bit.ly/3k1AUzj.

Acknowledgments

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Research in context

Evidence before this study

Civil unrest and non-authorized peaceful protests often lead to the use of crowd-control methods by law enforcement. Violent interactions between enforcing agencies and demonstrators have individual health consequences; however, less is known on population level indirect effects throughout large-scale social movements. We searched PubMed on November 19, 2020, with the terms (("civil unrest" OR "riots" OR "social movements" OR "protest" OR "demonstration") AND ("bullets" OR "less lethal weapons" OR "tear gas" OR "chemical irritants")) OR ("crowd control" OR "riot control"); no date nor language restrictions were used, and articles were selected based on the title and abstract. We found that most of the research linking social movements and crowd-control techniques were focused on individual and direct health effects: respiratory, dermatological, ocular or traumatic injuries, and disabilities caused by physical and chemical measures. Several mental-health effects have also been reported. Few research articles have described the number, patterns, severity, and treatments of injuries throughout times of riot. The effect of civil unrests and crowd control techniques on health services utilization and case severity have been less reported.

Added value of this study

This study used a flexible time-series analysis to quantify the effect of the social protests that started in October 2019 in Chile on emergency services utilization and inpatient admission. We looked specifically for emergency department consultations and hospital admissions (i.e., case severity) by both trauma and respiratory causes. We found that consultations by respiratory and traumatic causes decline during 2019's Chilean protest, but traumatic severe cases increased. The number of trauma hospitalizations increased by 15%, while hospitalizations per 1,000 consultations increased by 40%. Similarly, hospitalizations per 1,000 respiratory consultations were 59% higher than expected. Our results provide novel insights on the impact of social movements and widespread use of crowd-control methods on health service utilization.

Implications of all available evidence

This study adds to the existing body of evidence on the health effects of large-scale social movements. We demonstrated how health services utilization was likely to be affected by two main mechanisms: (1) access interruption due to the protest itself, which included fires and barriers constructed by protesters and the widespread use of irritant gases by the police, even near hospitals and other health services and, (2) the disproportional use of force from the police and the military during the periods of civil unrest. Taking into account the violence caused by riots and the measures utilized to control them, our results should be used to advise and advocate for policy change regarding crowd-control techniques and police response in order to prevent the escalation of violence and population health damage.

Table 1. Median emergency department weekly consultations and hospitalizations, pre and post "October 2019" social protests in Chile

	Previous to social protests *N=250 weeks*	During social protests *N=10 weeks*
Total consultations	3132 [2929; 3364]	2854 [2754; 2898]
Trauma consultations	806 [733; 888]	786 [752; 801]
Respiratory consultations	143 [120; 184]	96.0 [77·5; 103]
Circulatory consultations	102 [87·0; 126]	90.5 [87·5; 95·8]
Total hospitalizations	288 [268; 311]	298 [281; 332]
Trauma hospitalizations	60.0 [52·0; 67·0]	81.5 [77·5; 89·8]
Respiratory hospitalizations	19.5 [16·0; 23·8]	22.0 [15·5; 24·0]
Circulatory hospitalizations	29.0 [23·0; 36. ·0]	35.5 [30·5; 42·0]
Trauma hospitalizations per 1,000 consultations	73.0 [63·9; 86·3]	102 [84·2; 113]
Respiratory hospitalizations per 1,000 consultations	132 [108; 160]	233 [189; 270]

Note. Percentiles 25 and 75 in brackets.

Table 2. Estimated effects of October 2019 social protests on trauma and respiratory emergency department consultation and hospitalization

	Average Effect[a]	95% Credible Interval	Relative Effect (%)	95% Credible Interval
Trauma consultations	-136·76	-379·56, 108·88	-14·49	-40·22, 11·54
Respiratory consultations	-39·24	-116·74, 39·39	-30·04	-89·36, 30·15
Trauma hospitalizations	10·40	2·85, 18·75	14·65	4·01, 26·41
Respiratory hospitalizations	-1·48	-9·59, 6·76	-6·75	-43·63, 30·76
Trauma hospitalizations per 1,000 consultations	28·90	9·56, 49·75	39·53	13·07, 68·04
Respiratory hospitalizations per 1,000 consultations	85·50	42·65, 127·52	58·90	29·38, 87·85

[a]Estimated as the change in expected events per week during the exposure period.

Figure 1. Weekly differences between predicted and observed outcomes in the 10 weeks pre and post exposure periods

Figure 2. Cumulative difference between predicted and observed outcomes in the 10 weeks post exposure period