**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 equality. The government responded by declaring a state of emergency and deploying the Chilean army and police, who utilized anti-riot shotguns and tear gas as a means of crowd control.

*Aim*: To quantify the effects of the October 2019 Chilean protests on emergency health services utilization and inpatient admission rates in public hospitals near the protest focal point in Santiago, Chile.

*Methods:* We used a time series analysis of aggregated weekly emergency department (ED) admissions (2015-2019). Data from three public hospitals located around 3 km the focal point of the main protest in Santiago, Chile. The exposure period was defined as the onset of social protests on October 18 to December 31, 2019. We considered six outcomes, namely the number of weekly consultations and hospitalizations by trauma and respiratory causes, as well as the number 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).

*Results*: 148,141 ED consultations and 15,500 hospitalizations were observed in 2019. Health services utilization, assessed through ED consultations, declined during the social protests, though it 95%CrI included the null. In contrast, trauma hospitalizations increased by 16% (95% CrI: 2.75, 29.82), and the proportion of hospitalizations among consultant increased by 38% for trauma (95% CrI: 9.16, 65.07) and 63% for respiratory causes (95% CrI: 31.15, 96.13).

*Conclusion:* The October’s 2019 Chilean protests seem to affect the use of emergency health system services by lowering the number of consultations due to trauma and respiratory causes, but increasing the proportion of hopitalizations among admitted patients significantly. Crowd-control protocols must be reviewed to prevent adverse effects of civil unrests on population health.

**Keywords:** social protests; civil unrest; emergency department; trauma, respiratory, Chile

# **Introduction**

Throughout history, the world has continually witnessed social movements and civil unrest on the local, national, and global levels (1, 2). Social movements are defined as organized efforts by a group (or groups) of people working toward a common goal (3, 4). During a movement, participants may intentionally cause a public disturbance that violates the law, an act known as civil unrest (5). In Chile in October of 2019, 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 (health, education, transport, and justice systems), and retirement pensions, among other structural processes (6-9). 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 (10, 11).

Social movements have direct and indirect effects on health. Much of the current research linking social movements and health have focused on indirect effects of protest, demonstrations, and civil unrest. For instance, civil unrest and violence often expose people to stress, contributing to mental health burden (12-14). Similarly, the shutdown of city streets, disruption of public transportation, and damage to public and private infrastructure could affect health services utilization by restricting patient access (15-17). Emergency department (ED) consultations are heavily influenced by barriers to access (18-20) and serve as a measure of health services utilization.

Other mechanisms likely influence ED visits during civil unrest. Crowd control techniques such as pellet guns, tear gas, and other chemical irritants have been shown to have adverse effects on individual health, and the way these are used can impact the overall rate of ED consultations (21). Rubber bullets have been cited for causing eye injuries, lacerations, contusions, and hematoma (22-25). Burns and physical blows from batons, bottles, bricks, boots, and other objects also account for physical injury during protests (21, 24). 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 (17, 21, 25-28). 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) (29, 30).

Despite all this information, evidence regarding the effects of social movements on health is still lacking. To our knowledge, it has not yet been studied whether social movements and crowd control during civil unrest affects the admission rate or severity of the injury and respiratory cases at the population level.

In this study, we aimed to quantify the effects of the October 2019 Chilean protests and crowd-control techniques on emergency health system services utilization and inpatient admission rates in three large public hospitals near to the protest's focal point in Santiago.

# **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 was gathered from 2015 to 2019 for both consultations and hospitalizations and aggregated into a weekly basis. The data was then refined to isolate cases from ages 15-64 (because most protesters were within this age range (21)), and cases were defined according to their primary cause of admission.

Chile’s capital, Santiago, was one of the most affected areas 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 were within 1 kilometer of the “Plaza”.

*Data acquisition*

The data was obtained through the Chilean Department of Health Information and Statistics, which collects daily ED consultation and hospitalization 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 needing. Data is anonymized and tabulated by each center and reported to the Ministry of Health, which then publishes the datasets containing the aggregated counts by cause (trauma, respiratory, circulatory system) and center. The dataset is freely available on the web (http://www.deis.cl).

*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 rate of hospitalizations for each cause among people admitted for the same causes per 1,000.

Exposure. We defined the exposure period as the onset of social protests from October 18 to December 31, 2019, as this period concentrated most of the protests milestones (see Supplemental Table 1 with a timeline of these milestones). Because of 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.

Covariates. Finally, we used circulatory system causes as a negative control trend, assuming that most of these ED admissions were not directly or immediately affected during civil unrests. This covariate isolates the effects related to confounding changes due to difficulties to access to health facilities.

*Analysis*

To evaluate the effect of social protests on ED service utilization, we used Bayesian structural time series (*BSTS*) models (31) implemented using the *CausalImpact* R package (32) in R v4.0.2. 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) (33). The estimated effect is then the difference between the counterfactual and the observed number of consultations and hospitalizations following the social protest of October, 2019.

This method allows flexibility in the inference of counterfactuals, temporal evolution, and incremental attributable impact. Its estimations are achieved by incorporating features such as level, trends, seasonality and regression to capture the time series dynamics (34). 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 (35). The selected models assumed a studentized distributed noise, robust against outliers and shocks, plus a random-walk that does not rely on an observable pattern or trend drift and adapts to local variation, making it desirable when constructing short-term predictions (36).

The point effects of social protest and its 95% credible interval were generated as the difference between the estimated forecasts and the observed trend across each 30,000 Markov Chain Monte Carlo iterations, following a 10% burn-in period (31, 37, 38). The tail-area probability can be interpreted as the probability—across each model iteration— of observing a response is at least as extreme as the observed point estimate (39). 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 using historical controls from 2015 to 2018, that is, the observed trend for each outcome in the same three hospitals but in years in which the 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 the outcome (40). Inferences were computed with robust standard errors to account for heteroscedasticity and autocorrelation (41) using the *xtscc* command (42) in Stata 16 (43).

# **Results**

A total of 148,141 ED consultations with 15,500 hospital admissions of ages between 15-65 were registered throughout 2019 in the three hospitals under study. Median weekly consultations and hospitalizations were 2,847 and 300, respectively. Nineteen percent of consultations and 19% of hospital admissions of the year occurred in the exposure period (Table 1).

The weekly number of consultations and hospitalization by trauma and respiratory causes are shown in Figure 1. The number of respiratory ED consultations and hospitalizations show a clear seasonal pattern with a large increase in the winter months, though the relative (to the number of cases) severity of cases seems not to present and clear season variation. The number of trauma ED consultations and hospitalizations was higher than respiratory cases; however, the source of variation was mostly from the day of the week, concentrating the largest number of hospitalizations during the weekends.

Differences between model predictions and the observed data in the pre and post-October protests are graphed in Figure 2. For visualization reasons, we only present pre-exposure differences for the last 10 weeks prior to the social protests. Overall, model predictions fit well to the observed pre-exposure data for all the outcomes (Figure 2). The absolute and cumulative differences between the predicted and the observed trend are shown in Figures 2 and 3. Consultations dropped following social protests as well did the absolute number of respiratory hospitalizations. However, none of these trew results were statistically distinguishable from the null in the Bayesian time series model. However, the absolute number of trauma hospitalization, as well as the relative severity of consultations (rate between hospitalizations and consultations per 1000), increased following the social protests. The number of trauma hospitalizations increased by 16% (95% CrI: 2.75, 29.82; p= 0.010), while trauma hospitalizations per 1,000 consultations did so by 38%, relative to it counterfactual (95% CrI: 9.16, 65.07; p= 0.007); respiratory hospitalizations per 1,000 consultations increased by 63% (95% CrI: 31.15, 96.13; p < 0.001).

Sensitivity analysis showed consistent results in terms of both direction and magnitude of effects, though confidence intervals were narrower an excluded the null for trauma (-13%; 95% CI: -22.1, 3.5) and respiratory (-32%; 95% CI: -51.5, -12.1) consultations, but not for trauma hospitalizations (8%; 95% CI: -5.49, 22.11). As with the Bayesian approach, both trauma and respiratory hospitalizations per consultations showed increases in magnitudes of 32% (95% CI: 16.97, 47.15) and 53% (95% CI: 28.21, 77.64), respectively.

# **Discussion**

In this study, we aimed to quantify the effects of social protest and widespread of crowd-control techniques on population health, looking at the Chilean case. 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, though this decrease was not distinguishable from the null in our mail analysis; however, the severity of trauma and respiratory cases seemed to increase, which was particularly clear when we looked at the proportion of hospitalization per 1,000 trauma/respiratory ED consultations. Hospitalizations among consultants for trauma were 38% higher than expected, while for respiratory conditions was 63% higher. These results provide novel insights on the impact of social movements, violence during civil unrest, including police brutality on health service utilization and population health.

The overall decline in ED consultations can be likely 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 (15). In fact, public transportation was significantly disrupted throughout the time of the protests, particularly in the area surrounding the protest’s focal point. Also, 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 health professional volunteering, possibly decompressing ED from mild or non-life-threatening problems (9). However, the increase in the number and proportion of trauma hospitalizations during the social protest period suggests that confrontations and police brutality resulted in an increased number of civilians injured that needed medical attention. This is consistent with a previous study that evidenced an increment in severe ocular trauma by kinetic impact projectiles during this period (21) and a study that showed that levels of trauma increase 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 differences compared with 2018 (44).

Social movements resulting in civil unrest are far from being a Chilean or even a Latin American issue. Recent demonstrations have occurred for different reasons in countries such as Italy, France, Hong Kong, Syria, Colombia, Bolivia, Ecuador, Peru and the U.S. Furthermore, and they are expected to expand due to the crisis derived from COVID-19 (45, 46). One notorious example is the recent killing of George Floyd in Minneapolis, Minnesota, which triggered civil unrests in the U.S. and abroad. As in Chile, most of these protests resulted in the widespread use of anti-riot shotguns and tear gas as 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 confrontation and surrounding areas (10, 16, 47, 48).

*Implications*

This study's results should be seen as a first step in better understanding the broader health effects of largescale social movements, like October’s 2019 Chilean protests. We believe that our rigorous analytical approach could help to anticipate changes in ED consultation patterns during periods of widespread violence in surrounding areas and disruption of healthcare access and, thus, allocate efforts and resources accordingly. Second, and most importantly, we hope this study contribute to advocate for and advise policy change regarding police responses to civil unrest: authorities in Chile and worldwide must act now to reduce the broader negative health effects of social protests.

*Limitations*

The results of this study should be seed in 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 80% of the Chilean population have public health insurance (49) and likely use the public health system, there was a still fraction of the population that was not included in our study. In addition, the degree of detail of emergency data in Chile is far from being 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 as a consequence of 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’s 2019 Chilean protests seem to affect the use of emergency health system services by lowering the number of consultations due to trauma and respiratory causes, but increasing the proportion of hospitalizations among admitted patients significantly. It is necessary to implement policy changes regarding law enforcement actions and the use of crowd control measures during civil unrests in order to avoid negative effects on population health.

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**Figure 1. Trends of emergency department consultations and hospitalizations (2015-2019)**

Imagen que contiene Calendario

Descripción generada automáticamente

**Figure 2. Differences between model predictions and observed outcomes in the pre and post exposure periods**

Imagen que contiene Gráfico

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**Figure 3. Cumulative difference between expected and observed outcomes**

Gráfico

Descripción generada automáticamente

**Table 1. Summary descriptive table of emergency department consultations and hospitalizations, pre and port Ocober’s 2019 social protests in Chile**

|  |  |  |
| --- | --- | --- |
|  | **Previous to social protests** | **During social protests** |
|  | *N=252* | *N=10* |
| Total Consultations | 3137 [2924;3361] | 2854 [2754;2898] |
| Trauma Consultations | 802 [728;888] | 786 [752;801] |
| Respiratory Consultations | 143 [120;183] | 96.0 [77.5;103] |
| Circulatory Consultations | 102 [87.0;125] | 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 [15.0;23.2] | 22.0 [15.5;24.0] |
| Circulatory Hospitalizations | 29.0 [23.0;36.0] | 35.5 [30.5;42.0] |
| Rate of Trauma Hospitalizations per Trauma Consultations (x1,000 population) | 73.0 [64.0;86.2] | 102 [84.2;113] |
| Respiratory Hospitalizations per Respiratory Consultations (x1,000 population) | 131 [107;160] | 233 [189;270] |

Note. Median, and percentiles 25 and 75 in brackets. Total weeks (n=262).

**Table 2. Estimated effects of October’s 2019 social protests on the outcomes of interest a**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Outcome of Interest** | **Average Effect** | **95%Credible Interval** | **P-Value** | **Relative Effect (%)** | **95% Credible Interval** |
| Trauma Consultationsc | -99.00 | -357.47, 160.75 | 0.220 | -10.93 | -39.46, 17.74 |
| Respiratory Consultationsc | -63.27 | -144.80, 19.45 | 0.066 | -40.91 | -93.62, 12.57 |
| Trauma Hospitalizationsb | 11.30 | 1.92, 20.91 | 0.010 | 16.11 | 2.75, 29.82 |
| Respiratory Hospitalizationsb | -3.73 | -13.25, 5.92 | 0.218 | -15.38 | -54.70, 24.42 |
| Trauma Hospitalizations per consultations (x 1,000)d | 28.06 | 6.77, 48.13 | 0.007 | 37.93 | 9.16, 65.07 |
| Respiratory Hospitalizations per consultations (x 1,000)d | 88.98 | 44.13, 136.20 | <0.001 | 62.80 | 31.15, 96.13 |

a Each model had a structure of studentized distribution of errors, and a conservative prior standard deviation of .1

bModels also included circulatory hospitalizations as a control variable.

cModels also included circulatory consultations as a control variable.

dModels also included the proportion of circulatory hospitalizations of circulatory consultations (x 1,000 population) as a control variable.