**Supplementary material**

**Effects of 2019’s Social Protests on Emergency Health Services Utilization and Case Severity in Santiago, Chile**

1. **Dates of highlighted protest and/or larger social unrest**

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Event** | **Estimated participants** | **Source** |
| October 07 | Instituto Nacional’s secondary students evade subway (“Metro”) access without pay tickets. Students began to protest in small groups at metro stations the following days. | 80 | 1 |
| October 14 | More secondary and undergraduate students follow Metro fare hikes | 300 | 2 |
| October 18 | Mass protests began (rioting, looting, attacks on almost all 164 metro stations) in Santiago and major cities from Chile. | Thousands | 3 |
| October 19-24 | Massive demonstrations spread through the country. Stores and buildings were looted and/or burned. State of emergency is proclaimed in Santiago and then to other major cities: military and police were displayed; curfew is declared. | Thousands | 4-7 |
| October 25 | Biggest peaceful march across “Plaza Italia” in Santiago. Big demonstrations occurred also through the whole country. | 1.200.000 in Santiago | 8, 9 |
| November | Demonstrations continue in Santiago, with a major focus around “Plaza Italia” each weekend. Many severe civil injuries, ocular lost and deaths occurred. Human Rights organizations researched the events. Civil unrest, lootings and fires continued. | Unknown (probably thousands) | 10-13 |
| December 5 | “Las Tesis” feminist protest is peacefully done at the national stadium in Santiago. “A rapist in your part” is replicated worldwide | About 10.000 | 14, 15 |
| December | Civil unrest and deaths in demonstrations continued. | Unknown (probably thousands) | 16-18 |

A more detailed timeline of historical events (not only demonstrations) could be consulted at:

* Rodríguez, Á., Peña, S., Cavieres, I. et al. Ocular trauma by kinetic impact projectiles during civil unrest in Chile. Eye (2020). Supplementary material available at: https://static-content.springer.com/esm/art%3A10.1038%2Fs41433-020-01146-w/MediaObjects/41433\_2020\_1146\_MOESM1\_ESM.docx
* Ciudadanía Inteligente. Chronology on Chile’s inequality crisis. Available at: https://ciudadaniai.org/en/chile.html
* Estallido Social. Especial #18-O: los principales hitos del Estallido Social. <https://estallidosocial.com/especial-18-octubre/>
* Palacios-Valladares, Indira. Chile's 2019 October Protests and the Student Movement: Eventful Mobilization?.*Rev. cienc. polít*. 2020, 40(2):215-234.

1. **Supplementary statistical methods**

*Bayesian Structural Time-Series Analysis*

To evaluate the effect of social protests on ED service utilization we used Bayesian structural time series (*BSTS*) models {Scott, 2014 #7} implemented using the *CausalImpact* R package {Brodersen, 2015 #6}. This approach compares the observed trend of consultations and hospitalizations after the event, with an estimated average trend under an hypothetical scenario in which social protests did not occur (i.e., the counterfactual) {Pinilla, 2018 #4}. The estimated effect is then the difference between the counterfactual and the observed number of consultations and hospitalizations after the social protest of October 18, 2019. The general model can be written as follows:

One advantages of this method is that it allows flexibility in the inference of counterfactuals, temporal evolution, and incremental attributable impact. This estimation is achieved by incorporating features such as level, trends, seasonality and regression that capture the dynamics of the time series {Harvey, 2007 #1}. The first two components describe how the hospitalizations and consultations are related to underlying states and how the latent state changes over time. It is referred to as the unobserved trend inherent in time-series data. It is associated with a probability distribution of the noise and random disturbances, which allows to incorporate empirical priors on the parameter and transitory or cyclic components able to approximate volatility in the series. The third components are the seasonal patterns that capture the associations between multiple fixed periodic events and the number of consultations and hospitalizations. We specified monthly and annual seasonal patterns, based on theoretical backgrounds and the nature of admissions by its different causes (e.g., increase number of respiratory consultations during the winter season). The fourth component relates to other contemporaneous time-series that can be included as covariates via linear regression. We used as a covariate the circulatory hospitalizations when the outcome were hospitalizations,and consultations series when the outcome were consultations. Due to the length of the time-series, we used a dynamic framework which included the coefficients of time-varying regression, as a way to relax the assumption of stability of the model structure, and in which coefficients change over time according to a random walk process{Brodersen, 2015 #6}.

The model selection process considered alternative specifications in the structure of the time-series for each outcome: Gaussian or studentized distributed noise, different trend drifts such as a random-walk, a semi-local linear trend or a local linear trend, or the inclusion of cyclicity of autoregressive terms. We selected the model with lower cumulative absolute one step ahead errors in the pre-intervention period for each outcome {Koopman, 2000 #15}. The models that had lower errors assumed studentized distributions, which are robust against anomalities such as outliers . This comparison allowed us to choose the specified structure with the greater accuracy to match actual trends before social protests in order to strengthen causal inference {Scott, 2020 #11}.

Gibbs sampling was performed to produce 30,000 Markov Chain Monte Carlo (MCMC) iterations following a 10% burn-in period. The point effect of social protest and its 95% credible interval was generated as the difference between the estimated forecasts and the observed trend across the each iteration {Fragoso, 2018 #2}{Scott, 2014 #7}{Kruschke, 2018 #10}.

All analyses and graphics were completed using R v 4.0.2.

***Outcome Validity Testing***

The validity of results was tested analytically through mean comparison analyses for pre-exposure data and visually by observing the difference between actual and predicted cases in seven-day moving average plots during the pre-exposure time frame.

We used historical controls to contrast observed ED consultation and hospitalizations in the exposure period, that is, we used the same outcomes in the same hospitals, for the same time of the year, but in a different period (2015-2018).

**References**

1. Angélica Baeaza. Evasión masiva de alumnos del Instituto Nacional en el Metro termina con denuncia en Fiscalía y medidas de contención. La Tecera, Chile. October 11, 2019. Available at: https://www.latercera.com/nacional/noticia/evasion-masiva-alumnos-del-instituto-nacional-metro-termina-denuncia-fiscalia-medidas-contencion/857409/
2. Matias Vega. Grupo de 300 estudiantes invaden estación Pedro de Valdivia del Metro: protestan por alza de pasajes. biobiochile.cl, October 14, 2019. Available at: https://www.biobiochile.cl/noticias/nacional/region-metropolitana/2019/10/14/grupo-de-300-estudiantes-invaden-estacion-pedro-de-valdivia-del-metro-protestan-por-alza-de-pasajes.shtml#:~:text=Cerca%20de%20las%2012%3A37,ingresaron%20en%20masa%20al%20recinto.
3. John Bartlett. Chile students' mass fare-dodging expands into city-wide protest. The Guardian International Edition. October 18, 2020. Available at: https://www.theguardian.com/world/2019/oct/18/chile-students-mass-fare-dodging-expands-into-city-wide-protest
4. Aislinn Laing, Fabian Cambero. Chile's deadly weekend of fire as youth anger ignites. Reuters. October 21, 2019. Available at: https://www.reuters.com/article/us-chile-protests-scenes/chiles-deadly-weekend-of-fire-as-youth-anger-ignites-idUSKBN1X009A
5. Palacios-Valladares, Indira. Chile's 2019 October Protests and the Student Movement: Eventful Mobilization?.*Rev. cienc. polít*. 2020, 40(2):215-234.
6. Rachael Bunyan. 18 Killed as Hundreds of Thousands of Protestors Take to the Streets in Chile. Here’s What to Know. Times. October 25, 2019. Available at: https://time.com/5710268/chile-protests/
7. Associated Press. Chile: protests rage as president extends state of emergency. The Guardian International Edition. October 21, 2019. Available at: https://www.theguardian.com/world/2019/oct/20/chiles-president-reverses-fare-increase-as-unrest-continues
8. BBC News Mundo. Protestas en Chile: la histórica marcha de más de un millón de personas que tomó las calles de Santiago. BBC New Mundo. October 25, 2019. Available at: https://www.bbc.com/mundo/noticias-america-latina-50190029
9. Dave Sherwood, Natalia A. Ramos Miranda. One million Chileans march in Santiago, city grinds to halt. Reuters. October 25, 2019. Available at: https://www.reuters.com/article/us-chile-protests/one-million-chileans-march-in-santiago-city-grinds-to-halt-idUSKBN1X4225
10. Sandra Cuffe. One month on: Protests in Chile persist despite gov’t concessions. Aljazeera. November 19, 2019. Available at: https://www.aljazeera.com/news/2019/11/19/one-month-on-protests-in-chile-persist-despite-govt-concessions
11. John Bartlett and Liam Miller. Chile security forces' crackdown leaves toll of death and broken bodies. The Guardian International Edition. November 25, 2019. Available at: https://www.theguardian.com/world/2019/nov/25/chile-protester-killed-mother-army-police-romario-veloz
12. BBC News. Amnesty International: Chile using violence as a deterrent. BBC News. Noveber 21, 2019. Available at: https://www.bbc.com/news/world-latin-america-50512093
13. Human Rights Watch. Chile: Police Reforms Needed in the Wake of Protests. Human Rights Watch, 2019. Available at: https://www.hrw.org/news/2019/11/26/chile-police-reforms-needed-wake-protests
14. Paulina Abramovich, Agence France-Presse. 'The rapist is you': Chile anthem against sexual violence goes viral. ABS CBN News. December 6, 2019. Availablet at: https://news.abs-cbn.com/overseas/12/06/19/the-rapist-is-you-chile-anthem-against-sexual-violence-goes-viral
15. Charis. McGowan. Chilean anti-rape anthem becomes international feminist phenomenon. The Guardian International Edition. December 6, 2019. Available at: https://www.theguardian.com/world/2019/dec/06/chilean-anti-rape-anthem-becomes-international-feminist-phenomenon
16. Inter-American Commission on Human Rights. CIDH condena el uso excesivo de la fuerza en el contexto de las protestas sociales en Chile, expresa su grave preocupación por el elevado número de denuncias y rechaza toda forma de violencia. Organization of American States (OAS). December 6, 2019. Available at: https://www.oas.org/es/cidh/prensa/comunicados/2019/317.asp
17. AFP. Protesters clash with police as Chile unrest enters 50th day. New Straits Times. December 7, 2019. Available at: https://www.nst.com.my/world/world/2019/12/545665/protesters-clash-police-chile-unrest-enters-50th-day
18. Andres Martínez et al. Pictures, Violence in Chile resurges. Reuters. December 16, 2019. Available at: https://www.reuters.com/news/picture/violence-in-chile-resurges-idUSRTX7ASQH