Effects of Lockdown Lifting on COVID-19 Incidence and Mortality in Pakistan: A Statistical Analysis

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Abstract

We present a timely evaluation of health effects of COVID-19 related lockdown events in Pakistan. Using parametric t tests and non-parametric Wilcoxon signed ranks tests we find that the coronavirus cases and deaths in the four-weeks after lockdown lifting are significantly greater than those reported over the same time periods during lockdown. This paper is meant to aid in handling interventions to manage COVID-19 outbreak across the Asia and Pacific region, especially to the ones that have similar settings of health care systems and economic development. However, the direct economic and environmental effects of imposing and easing lockdown measures remain a matter of further investigation.

Keywords

coronavirus, COVID-19, lockdown, pandemic, Pakistan, paired sample t-test, Wilcoxon signed ranks test

1 | INTRODUCTION

The COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing pandemic of viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak was first emerged in Wuhan, China in December 2019. Global confirmed cases of COVID-19 have been reached over 10 million (Worldometeter.info 2020), and people around the world are facing extraordinary changes to their daily life due to the restrictions imposed to slow the spread of virus. The majority of countries around the world, including Pakistan, find themselves between two circumstances: the economic well-being and medical care of the population, both of which are threatened by ”Covid-19” virus. Leaders across the globe are facing this dangerous situation and making decisions about lifting lockdown policies, with anticipated healthcare, environmental, socio-economic, and political consequences (Gilbert et al. 2020).

According to recent COVID-19 spread data, Pakistan has not only passed the neighboring China but also ranked 12th country with highest COVID-19 confirmed cases (Worldometeter.info 2020). The nationwide tally of Covid-19 patients stands at 198,833 with 72,880 cases in Punjab, 76,318 in Sindh, 24,943 in Khyber-Pakhtunkhwa, 10,116 in Balochistan, 1,417 in Gilgit-Baltistan, 12,206 in Islamabad and 1,003 in Azad Jammu and Kashmir, as of June 28, 2020, 07:25 GMT+5 (Covid.gov.pk 2020).

In response to the COVID-19 pandemic, in addition to the more routine public health measures, Pakistan implemented “lockdown”, as an important tool to curb virus spread. On February 26, Pakistan reported its first case of COVID-19 in Karachi, the capital city of Sindh province. On March 13, the federal government announced a nationwide response, including closing borders with Iran and Afghanistan, prohibiting large public gatherings, closing schools, screening of passengers at airports, and establishment of isolation centers with basic facilities. A few days later, the province of Sindh went into complete lockdown while Punjab partially started from March 24. The military supported provincial governments, in the implementation of stringent measures to deal with the spread of the virus.

As the situation develops, Pakistan's main concern was to balance public health needs with the pressure COVID-19 places on its already weak economy. Despite criticism from medical professionals and opposition politicians, the Prime Minister of Pakistan Imran Khan has continued to ease lockdown restrictions saying the country's ailing economy would collapse and the poorest among the country's 220 million would die of hunger. Eventually, on May 9, Pakistan's government eased a nationwide lockdown initially imposed as a preventive measure against the COVID-19 spread. The decision to lift lockdown in Pakistan was largely influenced by its socio-economic structure. The livelihood of majority of Pakistanis depend on the informal sector (Ahmad 2020). Already, as many as 30 percent Pakistanis are living at or below the World Bank's poverty line of USD 1.90 a day. There are anxieties that people may die from other non-pandemic deaths (Mamun and Ullah 2020) if the national economy went into a crash due to prolonged lockdown restrictions.

Researchers have reported positive contributions of lockdown to various COVID-19 outcomes. For example, a study from China concluded that lockdown measures significantly reduce growth rate and increase doubling time of COVID-19 cases (Lau et al. 2020). Another study from China used province level data and found that social distancing measures are effective in reducing virus infection and deaths (Figueiredo et al. 2020). In developed countries, restriction policies were found to be efficient in reducing contact rate and the number of infectious cases (Roques et al. 2020). Some studies have also analyzed the impact of lockdown measures on environmental indicators (Berman and Ebisu 2020; Cadotte 2020; Cole, Elliott, and Liu 2020; Fan et al. 2020; Gupta, Tomar, and Kumar 2020; Ward, Xiao, and Zhang 2020; Xu et al. 2020). While, no study has yet reported the health implications of lifting lockdown. Given this, the aim of this study is to evaluate whether lockdown lifting has the potential to speed-up the virus' spread and deaths. In this current environment, it is crucial to understand and assess the effect of these measures and policies, as their consequences remains unclear.

2 | MATERIALS AND METHODS

We downloaded data covering the COVID-19 pandemic until June 27, 2020, from Our World In Data (Max et al. 2020). This global database is updated daily and offer free access to country-level information on various pandemic related indicators. The data used in this study are total confirmed cases, daily new cases, total deaths, and daily new deaths, which is sufficient to build and assess statistical models. Data were analyzed using IBM SPSS Statistics for Windows software, Version 21.0. (IBM Corp, Armonk, NY) for statistical analysis. We calculated mean values of above-mentioned variables for three time periods: during lockdown [(first four-weeks of lockdown (March 22nd to April 18th) and last four-weeks of lockdown (April 12th to May 8th)], and four-weeks after lockdown lifting (May 9th to June 6th). The calculation of mean scores was based on both raw variables and "normalized" by the number of checks performed during the same time periods. We used paired sample t tests to compare means of variables between post-lockdown-lifting period and two lockdown periods (i.e., first and last four-weeks).

3 | RESULTS

3.1 | MAIN RESULTS

Table 1 summarizes mean scores of COVID-19 cases and deaths in Pakistan during lockdown and post-lockdown-lifting periods. Columns 1-3 in Table 1 show mean scores during three different time periods (that is first four-weeks of lockdown and last four-weeks of lockdown, and four-weeks after lockdown lifting). Column 4 lists differences in mean values (of all variables) between first four-weeks under lockdown and four-weeks after lockdown lifting. The last column shows mean differences between last four-weeks under lockdown and four-weeks after lockdown lifting. It is noteworthy to note that the mean differences of all variables of study, i.e., total confirmed cases, daily new cases, total deaths, and daily new deaths exhibit significant rise after lockdown lifting when compared with the mean scores of first and last four-weeks after lockdown implementation. Table 1 indicates that the number of total confirmed cases of COVID-19 has increased sixteen times from lockdown average of 3240.39 (first four-weeks) to 52939.71 (after lockdown lifting). The average of daily new cases also increased from 249.50 to 2264.71, depicting an increase of nine times. Total deaths and daily new deaths also increase from 49.60 to 1117.71 (twenty-two times) and 5.00 to 44.42 (nine times), respectively. There are also significant differences in the means of all variables during lockdown (last four-weeks) and after lockdown lifting periods. All the variables are statistically significant at 0.01 level.

.........[Insert **Table 1**].........

Since the epidemic has started in Pakistan, the government is utilizing its resources to increase COVID-19 testing capacity across the country. Thus, it is important to note that the gradual increase in testing capacity may have significant contributions in the identification of daily new cases which would be ultimately reflected in the total confirmed cases. Given this belief, we performed paired t tests after normalizing raw variables by COVID-19 checks performed across country. Table 2 presents results of paired t tests based on normalized data. Almost all the results are consistent with those based on raw variables (Table 1) with the exception of mean differences of daily new cases and daily new deaths (between the periods of first four-weeks of lockdown and four-weeks after lockdown lifting), they are not statistically significant.

.........[Insert **Table 2**].........

3.2 | SENSITIVITY ANALYSIS

Comparing only mean differences of variables could raise concerns about the robustness and reliability of our results. Thus, we performed sensitivity analyses using Wilcoxon signed ranks test, a non-parametric alternative to the paired t test. Sensitivity analyses indicate that our inferences drawn from t tests are robust to comparing medians of variables before and after lifting COVID-19 lockdown (Appendix 1 and 2).

4 | DISCUSSION

Our results indicate that lockdown lifting has adversely affected the health of Pakistani population at large scale. The population of Pakistan has been paying great price for lockdown lifting. The outcome reveals a significant increase in total confirmed cases, daily new cases, total deaths, and daily new deaths after easing lockdown restrictions. COVID-19 is spreading fast in comparison with other respiratory diseases like severe acute respiratory syndrome (SARS). It will take long term planning and effective measures to curb the growth of pandemic of COVID-19. There is no known vaccine of COVID-19 at present (Anderson et al. 2020). The only way to tackle this pandemic is to follow the preventive measures. The government should use all means of communication to launch a vigorous awareness campaign to educate the people about the detrimental health effects of COVID-19. A recent study suggested that Pakistani masses are not well aware of the COVID-19 and strategies for the prevention and control of infection (Khan et al. 2020). Social media can play a vital role in this regard. WHO also recommends that societies ought to be educated, involved and enabled to adapt to a "new norm" (WHO 2020). Pakistan´s decision to implement lockdown was greatly admired by international bodies like WHO but lockdown ease made the situation worse as the number of infections and deaths have increased drastically.

Little number of COVID-19 tests are being performed on the population. Further, majority of Pakistani population cannot afford to pay high fee of COVID-19 test. The government of Pakistan should take steps to increase the COVID-19 testing by making COVID-19 test free of cost. WHO issued some guidelines regarding lockdown lifting like countries should improve its health system on war footing to spot, test, sequester, and treat new cases before lifting lockdowns. Unfortunately, the health system in Pakistan is not fully developed yet and hospitals in Pakistan have become the breeding ground of COVID-19 virus. Exponential growth of COVID-19 can also be tackled through massive testing. The patients can be isolated timely after massive screening that would deter the growth of COVID-19 in Pakistan. The government can establish the COVID-19 camps to raise awareness and carry out tests at national level.

WHO recommended another criterion for lockdown lifting: that is social distancing. Unluckily, Pakistani population avoid following the social distancing norms in their routine business that bring about phenomenal increase in COVID-19 cases. Transmission rate can be minimized by following social distancing and wearing face mask. Pakistan must adopt the Chinese model of lockdown lifting: China lifted the lockdown but ensured the strict social distancing in addition to massive testing and screening in Wuhan in order to avoid the resurgence of COVID-19 (Gilbert et al. 2020). However, Pakistan is not as developed as compared to China. Lack of resources makes it difficult for Pakistan to carry out massive testing.

The pandemic has adversely affected the world economic system and Pakistan is not an exception to this. Majority of Pakistani population is not that rich and face risk of starvation instead of the COVID-19. Almost all wage earners are deprived of employment due to lockdown. It is very hard for a common man to make ends meet in this time of crisis. To provide relief to its citizens, the government of Pakistan unveiled the first economic relief package worth 900 billion rupees. It was a good initiative but more needs to be done. The pandemic has generated so much apprehension and stress. People need psychological support to handle the apprehension and stress caused by this pandemic.

We suggest that government should follow WHO recommendations and impose periodical lockdowns while monitoring the conduct and activities of the people. Only one person from each family should be allowed to go out once a day to purchase necessities such as food and medicine. Local spread of pandemic can be minimized by screening the essential services like health care, transport, and food industry. Business organizations must devise new infection control policies regarding the COVID-19 if they need to reopen their business after the lockdown. Business owners and managers must arrange disinfection materials, like sanitizing walk-through-gate, hand sanitizer, masks and temperature screening at single entrance. Organizations must constitute departmental committees for reporting the suspected cases of COVID-19 among their colleagues. Unnecessary travel should be restricted by government to prevent the spread of pandemic. Further, imported cases can be avoided by enforcing strict rule of fourteen days quarantine for international travelers.

The present study has some limitations. First, we only check the impact of lockdown lifting in Pakistan. Researchers are encouraged to conduct more studies on this topic in other countries with similar socio-economic settings because this pandemic is affecting different countries in different ways. Second, the focus of the present study is limited to COVID-19-related health outcomes. Our understanding on the impact of lockdown events and policies on non-pandemic-related health outcomes is still incomplete. It will be interesting to know how lockdown restrictions contributed to the other health risks.

5 | CONCLUSIONS

In conclusion, the findings of this study are concerning, since they do suggest there may still be widespread transmission in the country. Preventive measures that could reduce cases such as limits on mass gatherings and crowded shopping areas, and emphasizing social distancing should be reinstated.

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CONFLICT OF INTEREST

No conflict of interest is declared.

ETHICAL APPROVAL

The authors confirm that the ethical policies of the journal, as noted on the Journal's author guidelines page, have been adhered to. No ethical approval was required as the COVID-19 data was accessed from the public (ourworldindata.org) domain.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from ourworldindata.org. These data were derived from the following resources available in the public domain: https://github.com/owid/covid-19-data/tree/master/public/data.

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Table 1. Results of Paired T-test based on raw data

Variables	**Mean scores**	**Mean scores**	**Mean scores**	**Mean difference**	**Mean difference**
	(1) During lockdown (first 4-weeks)	(2) During lockdown (last 4-weeks)	(3) After lockdown (first 4-weeks)	(4) [(3) – (1)]	(5) [(3) – (2)]
Total confirmed cases	3240.39	12681.78	52939.71	49699.32 *** (16.89)	40257.92 *** (18.71)
Daily new cases	249.50	758.42	2264.71	2015.21*** (12.09)	1506.28 *** (11.53)
Total deaths	49.60	274.57	1117.71	1068.11*** (17.09)	843.14 *** (22.13)
Daily new deaths	5.00	18.85	44.42	39.42 *** (12.23)	25.57 *** (9.48)
Notes: Absolute value of t-statistics in parentheses; *, **, *** Significant at 10%, 5%, and 1% levels respectively.	Notes: Absolute value of t-statistics in parentheses; *, **, *** Significant at 10%, 5%, and 1% levels respectively.	Notes: Absolute value of t-statistics in parentheses; *, **, *** Significant at 10%, 5%, and 1% levels respectively.	Notes: Absolute value of t-statistics in parentheses; *, **, *** Significant at 10%, 5%, and 1% levels respectively.	Notes: Absolute value of t-statistics in parentheses; *, **, *** Significant at 10%, 5%, and 1% levels respectively.	Notes: Absolute value of t-statistics in parentheses; *, **, *** Significant at 10%, 5%, and 1% levels respectively.

Table 2. Results of Paired T-test based on normalized data[a]

Variables	**Mean scores**	**Mean scores**	**Mean scores**	**Mean difference**	**Mean difference**
	(1) During lockdown (first 4-weeks)	(2) During lockdown (last 4-weeks)	(3) After lockdown (first 4-weeks)	(4) [(3) – (1)]	(5) [(3) – (2)]
Total confirmed cases	0.095	0.083	0.116	0.020 *** (3.56)	0.032 *** (11.04)
Daily new cases	0.164	0.093	0.165	0.000 (0.02)	0.071 *** (11.53)
Total deaths	0.000	0.001	0.002	0.001*** (28.20)	0.000 *** (9.70)
Daily new deaths	0.002	0.002	0.003	0.000 (1.15)	0.000 *** (3.11)

Notes: Absolute value of t-statistics in parentheses; $^{*, **, ***}$ Significant at 10%, 5%, and 1% levels respectively. ^{a}The ratio between raw variables and corresponding category of tests performed (i.e., total tests and daily new tests).	Notes: Absolute value of t-statistics in parentheses; $^{*, **, ***}$ Significant at 10%, 5%, and 1% levels respectively. ^{a}The ratio between raw variables and corresponding category of tests performed (i.e., total tests and daily new tests).	Notes: Absolute value of t-statistics in parentheses; $^{*, **, ***}$ Significant at 10%, 5%, and 1% levels respectively. ^{a}The ratio between raw variables and corresponding category of tests performed (i.e., total tests and daily new tests).	Notes: Absolute value of t-statistics in parentheses; $^{*, **, ***}$ Significant at 10%, 5%, and 1% levels respectively. ^{a}The ratio between raw variables and corresponding category of tests performed (i.e., total tests and daily new tests).	Notes: Absolute value of t-statistics in parentheses; $^{*, **, ***}$ Significant at 10%, 5%, and 1% levels respectively. ^{a}The ratio between raw variables and corresponding category of tests performed (i.e., total tests and daily new tests).	Notes: Absolute value of t-statistics in parentheses; $^{*, **, ***}$ Significant at 10%, 5%, and 1% levels respectively. ^{a}The ratio between raw variables and corresponding category of tests performed (i.e., total tests and daily new tests).

APPENDIX 1

Results of Wilcoxon signed ranks test based on raw data

Variables	**Medians**	**Medians**	**Medians**
	(1) During lockdown (first 4-weeks)	(2) During lockdown (last 4-weeks)	(3) After lockdown (firs
Total confirmed cases	2370.5	11547.5	51565.5
Daily new cases	209.5	767.0	1982.5
Total deaths	33.0	245.0	1084.0
Daily new deaths	4.0	1533.0	34.5

APPENDIX 2

Results of Wilcoxon signed ranks test based on normalized data

Variables	**Medians**	**Medians**	**Medians**
	(1) During lockdown (first 4-weeks)	(2) During lockdown (last 4-weeks)	(3) After lockdown (firs
Total confirmed cases	0.098	0.086	0.114
Daily new cases	0.091	0.097	0.163
Total deaths	0.001	0.002	0.002
Daily new deaths	0.001	0.002	0.003