The COVID-19 third wave in Myanmar following the military coup [version 2; peer review: 1 approved, 1 approved with reservations]

Spring Research Team

**Abstract**

**Background:** COVID-19 has disrupted health system of many countries, particularly worse in those resource limited settings including Myanmar. First and second waves in Myanmar during 2020 were effectively managed by the government. However, the momentum was disrupted due to the military coup in early 2021. This study aimed to analyse the situation of COVID-19 occurrence and death proportions during its third wave in Myanmar.

**Methods:** An online survey was conducted using a Google form. People with the symptoms of COVID-19 and those who died from COVID-19 between June-August 2021 were eligible to participate. The Google form was extracted into an Excel datasheet and analysed using Stata v16.1.

**Results:** Among the 29,171 participants, 76.7% were over 30 years old and 56.4% were female. A majority of participants were from highly populated regions: Yangon (17,220; 59%) (Business capital), Mandalay (3,740; 12.8%) and Sagaing (1,546; 5.3%). Participants sought health care from telegram/other online services (34%), home care by health care providers (22%), private clinics (13%) and public hospitals run under the military junta (5%). Overall, 15% of participants died, of which, 72% occurred at home and 17% at public hospitals. Significantly higher proportions of deaths were seen among participants over 60 years than other age groups and males (p<0.001). Death proportions at different weeks from June to August 2021 ranged from 12.4% to 17.3%, much higher than the military junta’s reports. Overall, 25% of participants received oxygen therapy.

**Conclusions:** Death proportions in different weeks were consistently high with limited access to public hospital care during the third wave. The data suggests that COVID-19 third wave severely hit Myanmar, with adverse outcome fueled by the military coup. However, the online Telehealth clinics operated by Ministry of Health, Myanmar National Unity Government, offered the alternative accessible solution for the certain population within the country.

**Keywords**

COVID-19, Myanmar, mortality, third wave
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Introduction

Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus and its occurrence was first reported in China in December 2019. The virus spread rapidly inside China and to all parts of the globe. The World Health Organization announced the COVID-19 outbreak as a Public Health Emergency of International Concern on 30th January 2020 and a pandemic on 11th March 2021. As of the end of April 2022, there were over 513 million confirmed cases and over 6.2 million deaths worldwide.\(^1,2\)

Most COVID-19 cases suffer from mild illness and do not require hospitalization.\(^3\) However, those with severe illness may need close monitoring and hospitalization.\(^2\) Mortality is generally low. Contextual factors that may reduce the COVID-19 mortality included adequate level of health care resources like doctors, nurses, hospital beds, strong primary health care, low rate of health privatization and wide health coverage.\(^5\) Public healthcare responses, efficiency of treatment, and COVID-19 variants may determine the COVID-19 severity and case fatality rate (CFR), which is defined as the number of total deaths divided by the total confirmed cases, shown in per cent. As of July 2020, the global mean and median CFR were 3.31% and 2.19%, respectively, with the highest rate of 27% in Yemen. North Europe and North America also documented a high CFR of more than 10%.\(^7\) CFR depends on the policies, responses, and efficiency of local healthcare systems, although its estimation has some flaws.\(^6\)

Myanmar had its first confirmed COVID-19 cases on 23rd March 2020. Since then, the first wave of COVID-19 in Myanmar lasted for about three months, followed by a second wave in August 2020. Country level coordination, risk communication, and surveillance at point of entry were initiated in January 2020; before the WHO declaration of a global health emergency. In response to the pandemic, an increased number of COVID-19 testing centres, community quarantine sites, fever clinics, contact tracing measures, and guidelines were timely implemented. Confirmed cases were admitted to the COVID-19 designated centres and tertiary care hospitals, which provided comprehensive care to lower the adverse consequences and fatalities (https://www.brookings.edu/blog/future-development/2020/12/01/myanmars-response-to-the-covid-19-pandemic/).\(^8\) The “National COVID-19 Call Centre” was established to provide correct and timely COVID related health information to the general community (https://dmr.gov.mm/officialannouncement/COVID_19CallCenter.pdf). The CFR during the first and second waves in Myanmar was 2.2%, which was similar to the global CFR.\(^9\)

The third wave of COVID-19 seriously hit Myanmar between June and August 2021, a few months after the military coup, which took place in February. People in Myanmar faced serious consequences of the COVID-19 pandemic, added to the disorganized health system impacted by the coup. Health workers in Myanmar have been oppressed by the military for providing medical care to injured protesting civilians and for participating in the Civil Disobedience Movement (CDM). The Insecurity Insight, Physicians for Human Rights (PHR), and John Hopkins University Center for Public Health and Human Rights (CPHHR) reported at least 252 attacks and threats against health workers and facilities during the first six months of the coup (https://phr.org/news/at-least-252-reported-attacks-and-threats-to-health-care-in-myanmar-during-six-months-of-military-crackdown/ (https://phr.org/our-work/resources/violence-against-health-workers-during-one-year-of-military-control-in-myanmar/)). Consequently, people had limited access to healthcare services even when they had severe COVID-19 symptoms. Critical shortages of oxygen and medicines and movement restrictions at night due to curfew further compounded the situation (https://phr.org/our-work/resources/violence-against-health-care-in-myanmar/) (https://crisis24.garda.com/alerts/2021/07/myanmar-authorities-to-implement-stay-home-orders-nationwide-july-17-25-update-38).

To mitigate the COVID-19 third wave under the impact of military coup and inefficient health care system, Ministry of Health of the National Unity Government (NUG) implemented the online telehealth clinics for treating the COVID-19 patients and established the COVID-19 knowledge centre Facebook page to disseminate the correct and timely health messages to the community.\(^1\) The NUG is the interim government formed by elected members of parliament, community leaders, representatives from Ethnic Resistance Organizations and CDM staff, and is recognized by the majority of
Myanmar went through a COVID-19 third wave differently due to the difficult situation following the military coup. Therefore, this current study aimed to document the situation of the COVID-19 third wave in Myanmar, using an online survey.

Methods
Study design and sampling procedure
This is a cross-sectional descriptive study, based on an online survey using a Google form. The weblink to the Google form was made available to the public through a number of online outlets of Ministry of Health, National Unity Government of Myanmar such as Facebook page, Signal and Telegram.

Data collection
Online data collection using a Google form was conducted between 1st August 2021 and 30th September 2021. The survey questionnaire was developed in the Myanmar language, after reviewing the literature and discussing with the relevant healthcare specialists. The questionnaire contained 13 questions and it took approximately 5 minutes to complete. Anyone who experienced COVID-19 symptoms themselves or family members staying in the same house, or knew someone who died from COVID-19 symptoms, between 1st June 2021 and 31st August 2021 (referring to the study period), could participate in the survey. There was no limitation or exclusion in age, sex, geographical areas of the participants. Efforts were made to minimize the sampling bias and to get the representative samples from the different geographical areas throughout the country by sharing the google form through the community networks from different regions.

Questions included in the assessment were background characteristics (age, sex, state/region), week of symptom onset, COVID-19 symptoms, COVID-19 testing and result, duration of illness, treatment seeking, oxygen therapy, outcome of disease, place of death (if the patient died).

Data analysis
The Google form was extracted into an Excel datasheet, which was analysed using Stata v16.1. All the participants (N=29,171) were included in the analysis, reporting subgroups and missing values in detail. Prior calculation of sample size was not done in order to recruit the eligible participants from all regions across the country. The age variable was cleaned for typos and for mixed Myanmar and English entries. The multiple-response variables were re-coded into binary variables for each response for analysis. The categories of the remaining variables were pre-defined. Descriptive analysis was performed to report the participants’ characteristics, by geographical regions; the patterns of COVID-19 symptom presentations, by outcomes such as recovered or death; the use of a healthcare facility for treating COVID-19 symptoms, by oxygen treatment; numbers of symptomatic participants in relation to proportions of death over the study period; and the place of death of the deceased participants. The survey was structured with simple questions for the general public, aiming to report the broad picture of the COVID-19 burden in the population; therefore, it did not allow further complex analysis. No multivariable analysis was done and only bi-variate analyses were applied to describe the overall situation during the third wave.

Ethical consideration
The first section of the Google data collection form provided the participants with the information on the survey and asked the participants’ consent to participate in the study. If they agreed to participate, they could continue answering the survey questions. The study strictly ensured the anonymity and confidentiality of the information. Questions focused only on the disease happening and did not include personal information except age, sex and geographic location. Ethical approval was not sought because of the non-functioning of almost all ethical boards in Myanmar due to the country’s political situation, and the low risk, anonymised nature of the data collection.

Results
Table 1 shows the COVID-19 symptomatic participant’s characteristics and geographical distribution. A total of 29,171 symptomatic participants were included in the assessment and 77% were from the major cities such as Yangon, Mandalay and Sagaing. Others included the remaining states and regions in Myanmar. The community from all the administrative states and regions participated in the study showing a nationwide coverage of the survey. In general, 76.7% were over 30 years of age and, specifically, the 31–45 years group was most commonly reported (29%). The proportion of females (56.4%) exceeded males (42.8%). Nearly 76% of the participants developed COVID-19 symptoms in the month of July.
Table 1. COVID-19 symptomatic participants’ characteristics and distribution in the country (June–August 2021).

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Yangon</th>
<th>Mandalay</th>
<th>Sagaing</th>
<th>Other States &amp; Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Total</td>
<td>29171</td>
<td>100.0</td>
<td>17220</td>
<td>100.0</td>
<td>3740</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤15y</td>
<td>648</td>
<td>2.25</td>
<td>363</td>
<td>2.13</td>
<td>83</td>
</tr>
<tr>
<td>16-30</td>
<td>6,071</td>
<td>21.05</td>
<td>3,440</td>
<td>20.2</td>
<td>805</td>
</tr>
<tr>
<td>31-45</td>
<td>8,402</td>
<td>29.13</td>
<td>5,075</td>
<td>29.8</td>
<td>1,116</td>
</tr>
<tr>
<td>46-60</td>
<td>6,723</td>
<td>23.31</td>
<td>3,838</td>
<td>22.54</td>
<td>868</td>
</tr>
<tr>
<td>&gt;60</td>
<td>6,997</td>
<td>24.26</td>
<td>4,314</td>
<td>25.33</td>
<td>822</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>16,452</td>
<td>56.4</td>
<td>9,862</td>
<td>57.3</td>
<td>2,056</td>
</tr>
<tr>
<td>Male</td>
<td>12,491</td>
<td>42.8</td>
<td>7,238</td>
<td>42.0</td>
<td>1,660</td>
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<tr>
<td>Other</td>
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<td>0.8</td>
<td>120</td>
<td>0.7</td>
<td>24</td>
</tr>
<tr>
<td><strong>Symptom onset</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>4,306</td>
<td>14.8</td>
<td>2,660</td>
<td>15.5</td>
<td>548</td>
</tr>
<tr>
<td>July</td>
<td>22,072</td>
<td>75.7</td>
<td>13,693</td>
<td>79.5</td>
<td>2,721</td>
</tr>
<tr>
<td>August</td>
<td>2,793</td>
<td>9.6</td>
<td>867</td>
<td>5.0</td>
<td>471</td>
</tr>
<tr>
<td><strong>COVID-19 test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tested</td>
<td>12,300</td>
<td>42.2</td>
<td>6,752</td>
<td>39.2</td>
<td>2,076</td>
</tr>
<tr>
<td>Not tested</td>
<td>16,129</td>
<td>55.3</td>
<td>9,999</td>
<td>58.1</td>
<td>1,585</td>
</tr>
<tr>
<td>Don’t know</td>
<td>742</td>
<td>2.5</td>
<td>469</td>
<td>2.7</td>
<td>79</td>
</tr>
<tr>
<td><strong>Test result among tested</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>11,075</td>
<td>90.0</td>
<td>5,980</td>
<td>88.6</td>
<td>1,924</td>
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<tr>
<td>Negative</td>
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<td>9.0</td>
<td>701</td>
<td>10.4</td>
<td>142</td>
</tr>
<tr>
<td>Unknown</td>
<td>113</td>
<td>0.9</td>
<td>71</td>
<td>1.1</td>
<td>10</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovered</td>
<td>12,764</td>
<td>43.8</td>
<td>7,604</td>
<td>44.2</td>
<td>1,685</td>
</tr>
<tr>
<td>Dead</td>
<td>4,404</td>
<td>15.1</td>
<td>2,631</td>
<td>15.3</td>
<td>570</td>
</tr>
<tr>
<td>Other*</td>
<td>12,003</td>
<td>41.2</td>
<td>6,985</td>
<td>40.6</td>
<td>1,485</td>
</tr>
</tbody>
</table>

Note: Sex = “others” are most likely due to that the respondents entered the data for multiple COVID-19 symptomatic observations and they didn’t know which one to select.

* n=330 (1.13%) missing.
* Other group includes participants who still had COVID-19 symptoms or experienced complications of COVID-19 at the time of survey.
### Table 2. Associations of participants’ background characteristics and disease outcomes (Total N=29,171).

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Alive</th>
<th>Dead</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Row %</td>
<td>N</td>
<td>Row %</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≤15 y</td>
<td>648</td>
<td>99.4</td>
<td>4</td>
<td>0.6</td>
</tr>
<tr>
<td>16-30</td>
<td>6,071</td>
<td>98.9</td>
<td>68</td>
<td>1.1</td>
</tr>
<tr>
<td>31-45</td>
<td>8,402</td>
<td>95.9</td>
<td>344</td>
<td>4.1</td>
</tr>
<tr>
<td>46-60</td>
<td>6,723</td>
<td>81.3</td>
<td>1,259</td>
<td>18.7</td>
</tr>
<tr>
<td>&gt;60</td>
<td>6,997</td>
<td>61.5</td>
<td>2,691</td>
<td>38.5</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female</td>
<td>16,452</td>
<td>88.6</td>
<td>1,869</td>
<td>11.4</td>
</tr>
<tr>
<td>Male</td>
<td>12,491</td>
<td>79.9</td>
<td>2,512</td>
<td>20.1</td>
</tr>
<tr>
<td>Other</td>
<td>228</td>
<td>89.9</td>
<td>23</td>
<td>10.1</td>
</tr>
<tr>
<td>Location</td>
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<td>0.199</td>
</tr>
<tr>
<td>Yangon</td>
<td>17,220</td>
<td>84.7</td>
<td>2,631</td>
<td>15.3</td>
</tr>
<tr>
<td>Mandalay</td>
<td>3,740</td>
<td>84.8</td>
<td>570</td>
<td>15.2</td>
</tr>
<tr>
<td>Sagaing</td>
<td>1,546</td>
<td>84.0</td>
<td>248</td>
<td>16.0</td>
</tr>
<tr>
<td>Other States &amp; Regions</td>
<td>6,665</td>
<td>85.7</td>
<td>955</td>
<td>14.3</td>
</tr>
</tbody>
</table>

*n=330 missing (1.13%).

### Table 3. Pattern of COVID-19 symptom presentation relating to outcomes.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Alive</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Total</td>
<td>29,171</td>
<td>100.0</td>
<td>24,767</td>
</tr>
<tr>
<td>Fever</td>
<td>24,539</td>
<td>84.1</td>
<td>20,926</td>
</tr>
<tr>
<td>Anosmia</td>
<td>19,857</td>
<td>68.1</td>
<td>18,431</td>
</tr>
<tr>
<td>Cough</td>
<td>19,147</td>
<td>65.6</td>
<td>16,519</td>
</tr>
<tr>
<td>Appetite loss</td>
<td>16,646</td>
<td>57.1</td>
<td>14,187</td>
</tr>
<tr>
<td>Muscle aches</td>
<td>15,342</td>
<td>52.6</td>
<td>13,542</td>
</tr>
<tr>
<td>Fatigue</td>
<td>15,307</td>
<td>52.5</td>
<td>12,318</td>
</tr>
<tr>
<td>Headache</td>
<td>10,820</td>
<td>37.1</td>
<td>9,852</td>
</tr>
<tr>
<td>Breathlessness</td>
<td>10,242</td>
<td>35.1</td>
<td>9,082</td>
</tr>
<tr>
<td>Runny nose</td>
<td>10,007</td>
<td>34.3</td>
<td>9,311</td>
</tr>
<tr>
<td>Sore throat</td>
<td>8,948</td>
<td>30.7</td>
<td>8,082</td>
</tr>
<tr>
<td>Diarrhoea/vomiting</td>
<td>7,797</td>
<td>26.7</td>
<td>6,649</td>
</tr>
<tr>
<td>Symptom duration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5 days</td>
<td>3,641</td>
<td>12.5</td>
<td>3,071</td>
</tr>
<tr>
<td>6-10 days</td>
<td>7,425</td>
<td>25.5</td>
<td>6,094</td>
</tr>
<tr>
<td>11-15 days</td>
<td>9,030</td>
<td>31.0</td>
<td>7,814</td>
</tr>
<tr>
<td>16 days or more</td>
<td>8,707</td>
<td>29.8</td>
<td>7,540</td>
</tr>
<tr>
<td>Don't know</td>
<td>368</td>
<td>1.3</td>
<td>248</td>
</tr>
<tr>
<td>Oxygen treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7,393</td>
<td>25.3</td>
<td>3,831</td>
</tr>
<tr>
<td>No</td>
<td>21,778</td>
<td>74.7</td>
<td>20,936</td>
</tr>
</tbody>
</table>

^Multiple response variable.
Over 42% received the COVID-19 test and 90% of their results were positive. Nearly 44% recovered from all symptoms while 15.1% had died at the time of the survey.

As mentioned in Table 2, the highest proportion of deaths was reported among the participants over 60 years (38.5%), which was followed by 18.7% between 46 to 60 years. Significant difference was detected in death proportions or case fatality rate according to age (p<0.001). A higher proportion of deaths was seen among males than females (20.1% versus 11.4%), which was significantly different (p<0.001). However, death proportions were not different according to the location.

The pattern of COVID-19 symptom presentation relating to outcomes is described in Table 3. Overall, fever (84.1%), anosmia (68.1%), cough (65.6%), appetite loss (57.1%) and muscle ache (52.6%) were the most common symptoms and generally similar presentations were seen among those who recovered. In contrast, among the deceased, fever (82%), breathlessness (75.7%), fatigue (67.9%), cough (59.7%), and appetite loss (55.8%) were presented most commonly. Symptoms mostly lasted between 11 and 15 days (31%), followed by a longer duration of 16 days or more (30%). Over 25% of participants (15% recovered and 81% in the deceased group) received oxygen treatment during their illness.

Table 4 describes the use of healthcare facilities for treating COVID-19 symptoms, shown by oxygen treatment. The participants most commonly used online or telehealth services (34.3%) among different healthcare points. Nearly 22%...
invited the healthcare provider for a home visit and 13% sought healthcare from private clinics. Very few participants (4.8%) received healthcare from public hospitals. Among those who were treated with oxygen, 43% and 35% were treated with online or telehealth services, respectively. Only 14% were treated at public hospitals.

Over the period of 1st June 2021 to 31st August 2021, the proportions of death ranged between 12.4% and 17.3%, with less variations throughout, despite the peak occurrence of COVID-19 in July week 2 (Figure 1). The majority of deaths (72%) happened at home and 18.3%, at public hospitals (Figure 2).

Discussion

The current assessment documented the situation of COVID-19 occurrence and death proportions during its third wave in Myanmar, which took place under the impact of the military coup. The data indicated that the peak incidence happened during the 2nd week of July 2021. Over half of the participants sought healthcare from Telegram/other online services and home care from healthcare providers. Significantly higher proportions of deaths were seen among older age groups (46 to 60 years and over 60 years) and males. Death proportions or CFR at different weeks were consistently over 12%. The majority of deaths occurred at home and only a few at public hospitals.

CFR is one informative epidemiologic tool that reflects the effectiveness of health policies, healthcare responses, and efficiency of health systems although its estimation has flaws. In the current study, CFR was consistently high at above 12% over the study period, which was, in fact, much higher than the announcement made by the military junta (3.7%). This study identified the overall death percent of 15.1%, while the global CFR remained 2.1%, according to the data as of July 2021. During the first and second waves, in Myanmar, the CFR showed 2.2% (3,100 deaths among 140,600 COVID-19 confirmed cases), which was comparable to the global CFR. This devastating increase in CFR in the third wave appears to be underpinned by the failed healthcare system following the coup.

COVID-19 deaths were different according to age group and gender. Based on the global data, death among males was 2.8% and that of females was 1.7%. With regards to the age group difference, the death rate was 3.6% in the 60–69 years old age group and 8% in the 70–79 years old group. Age group and gender differences in the current study were observed with much higher differences than that of the global data. Specifically, death among the older age group over 60 years was 38%, and that of males was 20%. This finding reflected an underlying vulnerability like old age had a greater impact of the limited healthcare access that leads to much higher mortality.

These adverse outcomes reflect the lack of essential healthcare for treating COVID-19 in Myanmar. This study identified that only a few COVID-19 symptomatic participants (4.8%) were treated at public hospitals with essential health facilities. Most participants, including those who received oxygen, were treated at places other than public hospitals. The findings highlighted that communities had limited access to the public hospitals run under the military junta. Before the coup, in 2015-2016, doctor population ratio was one doctor per 1,477 population which was below the WHO recommendation of one per 1,000 population. Existing weakness in human resources in health was fueled by the attack of the military on the healthcare providers and health facilities, including the diversion of medical supplies to military use. Furthermore, arresting healthcare workers providing COVID-19 treatment outside of junta-run facilities worsened the condition.

About one-quarter of COVID-19 symptomatic participants in the current study received oxygen therapy. Medical oxygen is an essential medicine in the treatment of COVID-19 for cases with hypoxemia and is related to disease severity. In a Chinese study, about 63% of COVID-19 patients under 65 years old admitted to hospital required oxygen therapy.

Figure 2. Places of death. Total N = 4,404.
and mortality was 2.9% among the oxygen therapy patients. In Myanmar, most COVID-19 cases were cared at home and given oxygen, when required, at home during the third wave. According to the news agencies, there were very high demands for oxygen in the community. Worse, the military junta set restrictions on the sale and importation of oxygen cylinders during the period (https://phr.org/our-work/resources/violence-against-health-care-in-myanmar/). Oxygen shortage was so severe that the family members of COVID-19 cases needed to queue for many hours to hire or get the oxygen cylinders filled. The crowded situation further precipitated the risk of disease transmission. Besides the oxygen shortage, rising pharmaceutical prices and shortage of medicines and other essential medical goods, including personal protective equipment (PPE), became a substantial strain on the Myanmar People.

Our study indicates that online/tele consultation was the most frequently used healthcare service for treating COVID-19. To address the healthcare needs of the community, the Ministry of Health of National Unity Government (NUG) had initiated telehealth free online clinics in June 2021. These telehealth online clinics cover 210 townships throughout the country within three months. Subsequently, COVID-19 specific Telegram channels were established in July. This service has provided consultation and treatment to more than 66,000 COVID-19 suspected and confirmed cases in 298 townships (90.3% of the total townships in Myanmar). These telehealth clinics were efficient in providing healthcare services for mild-to-moderate COVID-19 cases during the third wave. It was reflected in the current study as over one-third of the COVID-19 symptomatic participants sought care from the online telehealth services.

There were both strengths and limitations in the current study. High participation from the community throughout the country making a large sample with nationwide coverage was a key strength of the study. Due to the nature of the online survey, clinical details of the participants could not be collected, neither could verification information, such as COVID-19 test results. At that time, people from Myanmar experienced COVID-19 third wave and because of limited testing capacity and situation following the coup, most patients were diagnosed and treated according to the symptoms. As the study was available online only and encouraged voluntary participation of the public, it was unable to estimate the disease prevalence or mortality in the population.

## Conclusion

The study documented the high COVID-19 case fatality rates with limited access to public hospital care during the third wave in Myanmar. The majority of participants received tele/online healthcare services and home treatment. CFR at different weeks were consistently much higher than the global data and most deaths occurred at home with little tertiary care. The data suggests that COVID-19 third wave severely hit Myanmar, with adverse outcome fueled by the military coup. However, the online Telehealth clinics operated by Ministry of Health, Myanmar National Unity Government, offered the alternative accessible solution for the certain population within the country.

## Data availability


Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

## References

10. Ministry of Health, National Unity Government: **One year activities by MOH, NUG.**

Reference Source


Reference Source


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PubMed Abstract | Publisher Full Text


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Publisher Full Text
Nikos Kapitsinis

University of Copenhagen, Copenhagen, Denmark

The authors have successfully revised the paper, that has significantly improved. Nice work

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health geography, Geographies of pandemics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

In the introduction, second paragraph, I think it would very useful for the reader if the authors added and presented some socio-economic factors that affected the COVID-19 health implications. Several scholars have written about this. Illustrative studies that the
authors could include are:


- In the methods, the authors should explain more clearly and detailed how they distributed the online questionnaire, e.g. which online outlets they used. This will offer a more clear picture of methodology adopted.
- Moreover, the authors could present and describe whether the questionnaire included a question about the participant's status, i.e. whether he/she experienced COVID-19 or another person he/she knows. This is crucial to be clarified in the methodology section.
- The authors mention that over 42% of participants received the COVID-19 test. What about the others that reported they have been infected? Is there a question about how the participants realised/clarified that they had been infected by COVID-19? I.e. what about testing methods? The authors present it as one of the limitations of the study, in the discussion and they could elaborate a little more on this.
- I think the authors could present the questionnaire and its questions in the appendix.
- It would be useful if the authors presented some socio-economic data about Myanmar, in the discussion, and connect them with the capacity of the population to afford the private clinics and healthcare, but also the current status of public hospitals and healthcare in the country (number of doctors and medical beds per capita, for instance).
- They could also highlight the importance of the use of online consultation. What it means for the country, how it can help populations excluded from healthcare or quarantined and whether it could be more applicable in the future healthcare pathways.

**References**


**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Health geography, Geographies of pandemics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

---

**Comment 1:**
In the introduction, second paragraph, I think it would very useful for the reader if the authors added and presented some socio-economic factors that affected the COVID-19 health implications. Several scholars have written about this. Illustrative studies that the authors could include are:

**Response 1:**
Thanks for the suggestion. We added the socio-economic factors as you suggested in the second paragraph of the introduction as follows.
“Contextual factors that may reduce the COVID-19 mortality included adequate level of health care resources like doctors, nurses, hospital beds, strong primary health care, low rate of health privatization and wide health coverage (Kapitsinis N, 2021).”

**Comment 2:**
In the methods, the authors should explain more clearly and detailed how they distributed the online questionnaire, e.g. which online outlets they used. This will offer a more clear picture of methodology adopted.
Moreover, the authors could present and describe whether the questionnaire included a question about the participant’s status, i.e. whether he/she experienced COVID-19 or another person he/she knows. This is crucial to be clarified in the methodology section.

Response 2:
Thanks for the comments. We added more explanation about the distribution of online questionnaire. “The weblink to the Google form was made available to the public through a number of online outlets of Ministry of Health, National Unity Government of Myanmar such as Facebook page, Signal and Telegram.” Regarding the respondent, anyone who experienced COVID-19 themselves or anyone in the family members answered the questionnaire. We edited accordingly in the data collection section.

Comment 3:
The authors mention that over 42% of participants received the COVID-19 test. What about the others that reported they have been infected? Is there a question about how the participants realised/clarified that they had been infected by COVID-19? I.e. what about testing methods? The authors present it as one of the limitations of the study, in the discussion and they could elaborate a little more on this. I think the authors could present the questionnaire and its questions in the appendix.

Response 3:
Thanks for the comments. At that time, people from Myanmar had limited access to testing facility. We added more information on that issue in the limitation (last paragraph of the discussion section) as follows. “At that time, people from Myanmar experienced COVID-19 third wave and because of limited testing capacity and situation following the coup, most patients were diagnosed and treated according to the symptoms.” Regarding the questionnaire, we described the questions included in the 2nd paragraph of the data collection section under the method. Journal does not allow to put the appendix.

Comment 4:
It would be useful if the authors presented some socio-economic data about Myanmar, in the discussion, and connect them with the capacity of the population to afford the private clinics and healthcare, but also the current status of public hospitals and healthcare in the country (number of doctors and medical beds per capita, for instance). They could also highlight the importance of the use of online consultation. What it means for the country, how it can help populations excluded from healthcare or quarantined and whether it could be more applicable in the future healthcare pathways.

Response 4:
Thanks. We added more information of some socio-economic data in the fourth paragraph of discussion section according to your suggestion as follows. “Before the coup, in 2015-2016, doctor population ratio was one doctor per 1,477 population which was below the WHO recommendation of one per 1,000 population (Saw YM, 2019). Existing weakness in human resources in health was fueled by the attack of the military on the healthcare providers and health facilities, including the diversion of medical supplies to military use.”
Competing Interests: No competing interests were disclosed.

Reviewer Report 05 January 2023

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Su Myat Han
1 School of Tropical Medicine and Global Health, Nagasaki University, Nagasaki, Japan
2 School of Tropical Medicine and Global Health, Nagasaki University, Nagasaki, Japan

The COVID-19 third wave in Myanmar following the military coup

The current study added the value of the knowledge gap on the COVID-19 impact at the community level. The available research papers on the COVID-19 were mainly conducted at the hospital level and online people movement. This study particularly highlights the true burden of COVID-19 within the population.

Overall, this is a very good study, highlighting the disrupted health system and its impact on the health care sector response particularly at the pandemic situation of COVID-19. Below are the few comments and suggestions.

Abstract

Background: The first sentence of the background already concluding the severity of impact which is the main objective of the study. Background can be re-structured as “COVID-19 has disrupted health system of many countries including those developed nations. The impact is particularly worse in those resource limited settings including Myanmar. First and second waves in Myanmar during 2020 were effectively managed by the government. However, the momentum was disrupted due to the military coup in early 2021. People in Myanmar experienced serious consequences of the COVID-19 pandemic precipitated by the disorganized health system under the military junta. This study aimed to analyze the situation of COVID-19 occurrence and death proportions during its third wave in Myanmar.”

Conclusion: The conclusion of "The data suggests that the outcomes were adversely impacted by the military coup." is very strong, but the results of the study does not directly refer to this outcome.

I would suggest to improve the conclusion as:
"The data suggests that COVID-19 third wave severely hit Myanmar, adverse outcome fueled by the military coup. However, the online Telehealth clinics operated by Ministry of Health (MoH), Myanmar National Unity Government (NUG), offered the alternative accessible solution for the certain population within the country."
**Introduction:** Well written and structured.

**Method:** Given the descriptive nature of the study (exploratory), the current method and data analysis are enough for the study. However, given the large number of participants, regression analysis can be performed to see the factors associated with outcomes (recovered/death/complications). It is worthy to investigate risk of death (or) complications in association with cumulative symptoms (having two or more symptoms versus having only one) by applying multilevel poisson regression model.

**Results:**
Table (1): For those with outcome of death, who fill in the information in the google form. It would be great if the authors shared the survey google form (English translated version). For the COVID-19 test, what kinds of test the participants are taking (PCR, or rapid antigen test?). Is it included in the survey?

Table (2): p-value column needs to be corrected (between the age and sex category).

Table (3): OK, however, I noticed the variables are multiple response variables. It is worthy to investigate risk of death (or) complications in association with cumulative symptoms (having two or more symptoms versus having only one) by applying multilevel poisson regression model.

Table (4): It is better to recategorize the flow of the health care facility (for example: others should be the last one).

**Discussion:** Well written and discussed accordingly with the results.

**Conclusion:** The conclusion of "The data suggests that the outcomes were adversely impacted by the military coup." is very strong, but the results of the study does not directly refer to this outcome. I would suggest to improve the conclusion as:
"The data suggests that COVID-19 third wave severely hit Myanmar, adverse outcome fueled by the military coup. However, the online Telehealth clinics operated by Ministry of Health (MoH), Myanmar National Unity Government (NUG), offered the alternative accessible solution for the certain population within the country."

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: universal health coverage, health services, humanitarian aids

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 17 Jun 2023

Myo Myo Mon

Comment 1
The current study added the value of the knowledge gap on the COVID-19 impact at the community level. The available research papers on the COVID-19 were mainly conducted at the hospital level and online people movement. This study particularly highlights the true burden of COVID-19 within the population. Overall, this is a very good study, highlighting the disrupted health system and its impact on the health care sector response particularly at the pandemic situation of COVID-19. Below are the few comments and suggestions.
Response 1: Thanks so much for the comments.

Comment 2:
Abstract
Background: The first sentence of the background already concluding the severity of impact which is the main objective of the study. Background can be re-structured as “COVID-19 has disrupted health system of many countries including those developed nations. The impact is particularly worse in those resource limited settings including Myanmar. First and second waves in Myanmar during 2020 were effectively managed by the government. However, the momentum was disrupted due to the military coup in early 2021. People in Myanmar experienced serious consequences of the COVID-19 pandemic precipitated by the disorganized health system under the military junta. This study aimed to analyze the situation of COVID-19 occurrence and death proportions during its third wave in Myanmar.”
Response 2: Thanks. We revise it based on your suggestion and word count limit as follows.
“COVID-19 has disrupted health system of many countries, particularly worse in those resource limited settings including Myanmar. First and second waves in Myanmar during 2020 were effectively managed by the government. However, the momentum was disrupted due to the military coup in early 2021. This study aimed to analyse the situation of COVID-19 occurrence and death proportions during its third wave in Myanmar.”
Comment 3:
Conclusion: The conclusion of "The data suggests that the outcomes were adversely impacted by the military coup." is very strong, but the results of the study does not directly refer to this outcome.
I would suggest to improve the conclusion as:
"The data suggests that COVID-19 third wave severely hit Myanmar, adverse outcome fueled by the military coup. However, the online Telehealth clinics operated by Ministry of Health (MoH), Myanmar National Unity Government (NUG), offered the alternative accessible solution for the certain population within the country."
Response 3: We revise it according to your suggestion.

Comment 4:
Introduction: Well written and structured.
Response 4: Thanks

Comment 5:
Method: Given the descriptive nature of the study (exploratory), the current method and data analysis are enough for the study. However, given the large number of participants, regression analysis can be performed to see the factors associated with outcomes (recovered/death/complications). It is worthy to investigate risk of death (or) complications in association with cumulative symptoms (having two or more symptoms versus having only one by applying multilevel Poisson regression model.
Response 5: Thanks for your suggestion. However, as you also mentioned that the main objective of our study is to highlight the overall burden of the COVID-19 amidst the military coup, our current analysis addresses the main objective of the study.

Comment 6:
Results:
Table (1): For those with outcome of death, who fill in the information in the google form. It would be great if the authors shared the survey google form (English translated version). For the COVID-19 test, what kinds of test the participants are taking (PCR, or rapid antigen test?). Is it included in the survey?
Table (2): p-value column needs to be corrected (between the age and sex category).
Table (3): OK, however, I noticed the variables are multiple response variables. It is worthy to investigate risk of death (or) complications in association with cumulative symptoms (having two or more symptoms versus having only one) by applying multilevel poisson regression model.
Table (4): It is better to recategorize the flow of the health care facility (for example: others should be the last one).
Response 6: Table (1): For those with outcome of death, respondent is immediate family member of a deceased who stays together in the same house. Among the respondents, only 42% had received COVID-19 test. Over half of them were diagnosed and treated by the symptoms at that time. For the type of COVID-19 test, we cannot ask whether the test is PCR or RDT since most of them are lay people.
Table (3): Thanks for the suggestion. As we've explained above, the main objective of our
study is to highlight the overall burden of the COVID-19 amidst the military coup, our current analysis addresses the main objective of the study.

Table (4): Thanks. We recategorized the flow of health care facility as your suggestion.

Comment 7:
Discussion: Well written and discussed accordingly with the results
Response 7: Thanks

Comment 8:
Conclusion: The conclusion of "The data suggests that the outcomes were adversely impacted by the military coup." is very strong, but the results of the study does not directly refer to this outcome.
I would suggest to improve the conclusion as:
"The data suggests that COVID-19 third wave severely hit Myanmar, adverse outcome fueled by the military coup. However, the online Telehealth clinics operated by Ministry of Health (MoH), Myanmar National Unity Government (NUG), offered the alternative accessible solution for the certain population within the country."
Response 8:
Thanks. We revise according to your suggestion.

Competing Interests: No competing interests were disclosed.

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