COVID-19 Aftereffects (Long COVID) Associated with Wuhan, Delta, and Omicron Variants Reported in Japanese Hospitals

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ABSTRACT

COVID-19 patients who visited hospitals in Japan reported aftereffects, also known as Long COVID or Post COVID symptoms. The study compared the Long COVID symptoms caused by the original Wuhan, Delta, and Omicron variants. The analysis of COVID-19 lingering symptoms (Post COVID) conducted by researchers in Japan have been included. Symptoms may last from one month to one year, putting a strain on the health care system. According to a joint study done by Osaka University and Toyonaka City on patients mostly infected with Omicron, one in five patients experienced aftereffects one month after their recovery.

The report indicated that the symptoms improved over time. A majority of the patients reported difficulties with their daily activities. About 14% of the patients experienced aftereffects even one year after being discharged from hospitals, according to data recorded during Delta and previous waves that were presented to the Japanese government. Patients hospitalized during the Delta and Wuhan waves for SARS-CoV-2 infection showed a 50% reduction in symptoms between three and six months, according to a longitudinal follow-up study of sequelae. According to a gender-wise study, symptoms improved more quickly in women than in men. Compared to older patients, younger patients recovered a little faster in the first two months. Patients infected during the first four non-Delta waves recovered slower than those infected during the Omicron surge. Longitudinal studies of persistent symptoms are needed to develop treatments and possibly the COVID-19-specific drugs.

Keywords: Aftereffects, Long COVID, Wuhan strain, Omicron variant, Delta variant, SARS-CoV-2 mutation.

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I. INTRODUCTION

In a study conducted in Japan [1], it was found that many people who were infected with COVID-19 still suffered from the symptoms more than 6 months after initial diagnosis. Fatigue was the most common symptom (20%) among those who contracted the virus. However, in the initial stage of the infection, 78% of the patients experienced fever (above 37 °C) at the onset of symptoms or at the time of diagnosis till leaving the hospital. The fever, however, decreased to only 5% of patients after 6 months. In contrast, 21% of individuals still experienced fatigue. Professor Fukunaga Kōichi (Keio University, Japan) led the research and data were presented to the Ministry of Health, Labor and Welfare, Japan for the appropriate measures to control the COVID-19 pandemic. Other lingering symptoms included shortness of breath (13%), sleep disorder (11%), and decreased ability to think or concentrate (11%). Long COVID condition is serious, as even one lingering effect causes anxiety or depression. A total of 522 COVID-19 infected individuals who were admitted to the hospital were included in the survey. The survey covered the period from January 2020 to February 2021 (the first three waves, but not the fourth and fifth (Delta) waves). In the study mentioned above, 55% of participants were under the age of 60, while 45% were 60 years of age or older.

A team led by Professor Akihito Yokoyama (Kochi University, Japan) collected the above data after three months of hospitalization and found that 77.3% of critically ill patients still had muscle weakness and 50% (half) suffered from shortness of breath. In 30.2% of the patients, fatigue persisted. During the period from February 15 to September 17, 2021 (including the first four waves, no delta wave), long-term clinical data of COVID-19 patients were analyzed at the COVID-19 aftercare clinic (CAC) at a tertiary academic hospital in Japan [2]. The patients’ clinical and habitual
background along with the symptoms associated with the infection was recorded. A total of 87 infected Japanese individuals who visited the CAC were surveyed, with a median age of 40 years. Among them, 52.9% were females. The period between the onset of the infection and the visit to the clinic was 79 days. At the time of visiting the clinic, fatigue was the most common symptom (50.4%), followed by dysosmia, dysgeusia, hair loss, headache, dyspnea, and dysosmia in proportions of 28.7%, 26.4%, 18.4%, 17.2%, 16.1%, and 13.1%, respectively. The study covered the period, February–September 2021, and 79 days after the infection was first detected. It did not cover the Delta wave; only non-Delta waves were included. Researchers have investigated the decay of various symptoms: weight loss, fever, general fatigue, cough, sore throat, dyspnea, loss of appetite, dysgeusia, dysosmia, headache, dysosmia, and anxiety, changed over the time after the onset of the infection. Also, the % of the above symptoms present in the entire period has also been worked out. In the above cited article, the clinical characteristics of Japanese patients referred to an outpatient clinic with a focus on post-acute sequelae of SARS-CoV-2 infection (PASC) or long-term COVID-19 effects were studied. The detailed examination of the long-term COVID-19 aftereffects recorded in various countries in Europe and the US, China, and Japan has been published in a number of review articles [2] as well as the references included in this study. One-third to half of COVID-19 patients show residual symptoms for a relatively long time, even up to several months. The long-term aftereffects reported in Japan's clinics throughout diverse clinical situations and the viral load that emerged due to different waves have been covered in the above article. Results from both small and large sample sizes were reported. This is the first review article that compares patients’ data collected from different hospitals under different conditions.

For the COVID-19-infected patients who visited Okayama University Hospital's COVID-19 aftercare clinic (CAC) between February and December 2021, an aftereffect analysis was conducted [3]. The medical records of 186 patients were examined to determine the longevity of symptoms. In addition to general fatigue, the most common symptoms, the patients reported were dysosmia or dysgeusia, hair loss, headache, dyspnea, and sleep dysfunction. Long COVID has been defined as symptoms that last longer than one month after a person contracts the COVID-19 infection. In the above study, the medical records (age, gender, body mass index (BMI), underlying conditions (alcohol use and smoking patterns), hospitalization, oxygen support, medication, the number of days between the onset of infection and visiting the CAC clinic, the severity of the infection, vaccination record, and the type of clinical aftereffect symptoms were all considered. In terms of gender, 40% of all patients were men and 60% were women. The individuals were 40 years old on average. The percentage of patients who smoked and drank regularly was 41% and 43%, respectively. Due to COVID-19 infection, 29% of patients were admitted to hospitals, and 17% of those patients received oxygen or steroid therapy. A total of 76% of patients had mild, 22% had moderate, and 2% had severe symptoms, respectively. A total of 12% of the patients received one dose of vaccination, while 24% were fully vaccinated. Recipients were administered either BNT162b2 (Pfizer/BioNTech) or Moderna vaccines, with 64% of patients remaining unvaccinated. The median time from the onset of infection to the CAC clinic visit was 83 days. According to the above study, patients reported more than ten aftereffect symptoms of Long COVID at their initial visit, with five major symptoms, general fatigue (52.2%) being the most common, followed by dysosmia/dysgeusia (43.0%), hair loss (24.7%), headache (19.9%), dyspnea (15.6%), and insomnia (14.5%). The next two studies cover the first four non-Delta waves. Over 60% of COVID-19 hospitalized or recovering patients, according to a report prepared [4] for the Health Ministry (Japan), reported a loss of taste or smell. The survey included 251 COVID-19 aftereffect recovering patients. In one month, symptoms of altered taste and smell improved (symptoms decayed) in 60% and 84% of people, respectively. Another study found that people continued to have symptoms like fatigue, breathing problems, and a reduction in their capacity to think or concentrate even six months after the infection started. The data were presented at a meeting of the advisory board for the health ministry on June 16, 2021. Japan had four COVID-19 waves until June 2021. The findings demonstrated the pathogenic nature of the original Wuhan variant. Data from the Delta wave and those that followed were not part of the study. The research group led by Professor Takaki Miwa (Kanazawa Medical University, Japan) conducted the above survey. There were 251 patients in all. Patients who were either hospitalized or recovering after leaving the hospitals for their mild to moderate symptoms or who were asymptomatic were included in the survey. Only 20% of patients reported having a smell disorder, whereas 37% of patients reported both loss of taste and smell, and only 4% of patients experienced symptoms of taste loss. In over 60% of cases, the reported symptoms resolved within a month.

In a study headed by Professor Koichi Fukunaga (Keio University, Japan), six symptoms were examined: fatigue, breathing problems, muscle weakness, sleeping disorders, thinking and concentration difficulties, and hair loss. Over 30% of the infected individuals continued to experience COVID-19-related symptoms six months after leaving the hospital. At the time of leaving the hospital, 522 patients answered the survey whereas six months later, only 246 responded. Despite suffering from only one of the symptoms, COVID-19 patients reported a decline in quality of life. They suffered from sleeping disorders, anxiety, and depression. Approximately 80% of the individuals regained their normal health within six months of contracting the infection. Three months after the patients had recovered, Professor Akihito Yokoyama and his team examined the patients and found that the individuals who had severe symptoms were more likely to have pulmonary diffusion disorder, which makes difficult for the lungs to supply oxygen to blood vessels. Professor Hideki Ueno of Kyoto University in Japan conducted research on COVID-19 aftereffects [5] and found that women were more likely to experience aftereffects, particularly coughing, hair loss, and taste abnormalities. According to the study, the "T cells" in the human body that eliminate viruses are the reason why men's and women's immune systems differ from one another. The immune response system produces T cells when a virus invades the body. The generation of too many or too few T cells results in
aftereffects. Blood samples from 70 COVID-19 patients were analyzed, including those infected during the Delta wave and experiencing aftereffects. Ailments’ aftereffects vary depending on the number and kind of T cells produced in the immune system to eliminate the novel coronavirus. The number of T cells responsible for eliminating the virus and those controlling excessive immunological activity were found to be high in women who had severe symptoms of shortness of breath and heart pounding. The symptoms persisted as a result of an uncontrolled and disordered immune system. However, the above reactions were less pronounced in men, and a different mechanism is responsible for their aftereffects. Similar to this, the COVID-19 patients who had lower overall T cell counts also experienced more pronounced aftereffects of depression and concentration loss. It was speculated that because there are fewer T cells in the body, the virus's fragments cannot be removed from the body's organs, causing symptoms to persist for a long time. The body's immune system might respond to the Omicron differently from the previous Wuhan and Delta variants because it decays more quickly. More research can be done focusing on the T cells if it is widely established that these cells contribute to the aftereffect’s symptoms. A large-scale survey (1,000 patients) conducted for the Japanese health ministry focused on patients hospitalized between January 2020 and February 2021 (the first three non-Delta waves) has also confirmed that men and women experience aftereffects differently. Three, six, and one year after the diagnosis, the patients were followed to find out about their aftereffects. After three months, the proportion of patients who were still experiencing one or more symptoms dropped (decayed) to 46.3%. Six months and one year later, only 40.5% and 33% of patients exhibited symptoms, respectively. According to the gender-wise survey, 51.2% of women and 43.5% of men exhibited symptoms three months after the diagnosis. The symptoms in women improved to a lesser extent after three months. After one year, the difference between men and women who still had aftereffects narrowed down to 32.1% and 34.5% for men and women, respectively. Coughing, hair loss, headaches, and smell and taste disorders were the most common symptoms among women. While coughing, joint pain, muscle pain, and numbness were common in men.

The novel coronavirus (SARS-CoV-2) research group of Shervani et al. and others have published a number of articles and reviews on various aspects of the SARS-CoV-2 virus and COVID-19 disease [6]-[23]. Human-to-human and human-to-animal transmission of the SARS-CoV-2 virus [6], the use of supercomputers in the prevention and treatment of the disease [7], the initial attempts to make vaccines [8], and the discovery and treatment of COVID-19 [9] have been discussed. The Omicron surge in the Indian state of Karnataka has been studied [10] in relation to the % share of the Omicron lineage out of the total infection. To determine the pathogenicity and virulence of all three variants (original Wuhan, Delta, and Omicron), the data from Max Hospital (India) were studied [11]. The Omicron variant was found to be less harmful than the Wuhan and Delta strains when pathogenicity was compared in terms of CFR and hospitalization rate. A number of serological (SARS-CoV-2 antibodies) surveys were conducted in India, and the findings were published [12]-[16]. On the ground in the real world, the proportion (%) of antibodies produced through exposure to the virus and vaccination was determined. Recently published "health index theory" [17], [18] has established the Kerala's (state in India) high infection rate in comparison to the other Indian states. In Mumbai's Dharavi Slums (India), where 75% of the population had antibodies against the infection, the second and third COVID-19 pandemic waves did not hit the slums [19]. Sanitization methods and the stability of the SARS-CoV-2 virus were also discussed [20]. The vaccine breakthrough infections that occurred in India in the general population and HCWs were described in articles [21] and [22], respectively. In articles [23]-[25], the dynamics of the spread and severity of the Omicron variant were reviewed.

In this review article, we have analyzed the Long COVID data collected from the various hospitals in Japan. The aftereffect symptoms caused by different waves that hit Japan have been described. The term Long COVID referred to the symptoms that continue for one month or longer following the onset of the infection. The data from both small and large sample sizes were included. COVID-19 aftereffects records were collected from hospitals as mentioned in the following sections.

II. METHODS, PATIENTS’ STATUS, AND OTHER DETAILS
A. Omicron Infected Individuals

Mostly Omicron-infected patients who were in isolation at home were included in the survey (Figs. 1 and 2). The study was led by Prof. Satoshi Katsuna of Osaka University (Japan). A survey was conducted in July 2022 among Toyonaka city residents who were infected with the Omicron strain of the SARS-CoV-2 virus. The patient responded by mail or apps. As of March 2022, out of a total 26,880 individuals who were infected, 4,047 residents responded.

B. Pre-Delta and Post-Delta Wave Infected Patients

In Section III B (Fig. 3), a comparison of the health issues during the period September 2020-July 2021 when the Delta surge started and September 2020-September 2021 (Fig. 4) until the Delta wave was over has been described. The data in the figure are those presented at the Japanese Respiratory Society meeting, while the latter were presented to the Ministry of Health, Labor, and Welfare (Japan). The individuals were hospitalized patients in Japan. In Section III D (Figs. 5-8) the data were of the study period February-July 2021 (first 4 non-Delta waves). A study was done at Okayama patients who visited had smoking and drinking habits and had oxygen or steroid therapy already. A total of 73 days passed between the onset of the COVID-19 infection and the first visit to hospital or hospitalization. Patients’ health status and other survey conditions have been shown in Table I.

C. Omicron and First 4 non-Delta Waves Infected Individuals Comparison

A comparison of overall decay in the symptoms (aftereffects improvement with time) (Fig. 9) was also made between the Omicron (Section III A, Osaka University and Toyonaka City residents’ study) and first 4 non-Delta waves (Section III D, Okayama University Hospital study).
III. RESULTS AND DISCUSSION

A. Long COVID Caused by the Omicron Variant

The study (survey) conducted [26]-[28] by Osaka University and the city of Toyonaka (Osaka Prefecture, Japan) found that around 5% (5.2%) or one in 20 COVID-19-infected individuals still suffered from symptoms one month after the infection. The survey included mostly Omicron-infected, non-hospitalized patients who were in isolation at home. Professor Satoshi Katsuna of Osaka University (Japan) led the study. The survey was conducted in July 2022 among Toyonaka residents, mostly infected with the Omicron variant of the SARS-CoV-2 virus. Mail or apps were used to collect the responses of the patients. A total of 4,047 people responded with answers from 26,880 residents infected with COVID-19 by March 2022. Most respondents (77.3%) were estimated to have been infected with the Omicron variant of COVID-19 during the above period when Omicron surge was underway in Japan. After ten days of the infection onset and self-isolation, almost 48% (47.7%) of the respondents reported symptoms. About 5% (5.2%) reported health problems 30 days following the start of the disease. In 4% (3.7%) of the cases, the symptoms persisted for more than two months. The decay of the above-mentioned aftereffects with time (days) has been depicted in Fig. 1. According to the survey, individuals who had severe symptoms were about 5.4 times more likely to experience lingering aftereffects than those with mild symptoms. Compared to men, women were more likely to suffer aftereffects. The vaccination has reduced the chances of developing the aftereffects. Therefore, vaccination and preventative measures such as practicing 3Cs are essential for preventing infections. After 30 days, the COVID-19-infected patients reported the symptoms as shown in Fig. 2. The symptoms most patients (1.61%) suffered after one month of the onset of the disease was difficulty in daily life followed by the hair loss (1.41%) and coughing (1.28%). Fever was prevalent among 0.95% of infected individuals, while smelling difficulties and loss of taste were at 0.75% and 0.56%, respectively. Patients reported multiple symptoms they suffered. Soon after their recovery from the disease, 47.7% of the patients still had some symptoms.

B. Comparison of the Symptoms (Long COVID) Caused by the Waves, Including the Delta Wave and the Waves Before

Fig. 3 compares the symptoms reported during the waves, including the Delta wave (ruby-red bars) and the waves that hit Japan prior to the Delta surge (violet-blue bars). The study [29] surveyed hospitalized patients for aftereffects. Among the symptoms, one of the aftereffects was respiratory problems. Even one year after being released from the hospital, 14% (13.6%) of COVID-19 patients with moderate to severe symptoms continued to have side effects. Among the symptoms, one of the aftereffects was respiratory problems. On June 1, 2022, the findings were presented at the Japanese Respiratory Society (JRS) meeting. About 1,000 COVID-19 patients aged 20 or older were included in the study. The patients were admitted to the hospitals for breathing difficulties and pneumonia and needed oxygen support, ventilators, and intensive care treatment. Data were collected between September 2020 and September 2021 which included the infection caused by the Delta wave as well.
Through queries and answers, the patients' responses were collected. Muscle loss (9.27%), respiratory issues (6%), and fatigue (4.9%) were the patients' most frequent long-term symptoms, whereas 6.3% of patients had abnormalities in their lung CT scans. According to the study, interstitial pneumonia caused lung abnormalities in COVID-19 patients more frequently than pneumonia resulting from other illnesses. Patients with severe symptoms reported more aftereffects. The research mentioned above was conducted at Kochi University (Japan) under the guidance of Akihito Yokoyama. Just 17% of patients with persistent symptoms received treatment within one year after hospital discharge. Health officials are facing challenges in providing long-term medical support. The survey analyzed [30] the data collected at the beginning of the Delta spike, excluding the infections that occurred during the Delta wave. According to the survey conducted by the Japanese Ministry of Health, Labor, and Welfare, about 10% of hospitalized patients continued to experience aftereffects one year after being discharged. At 7.4%, decreased muscle strength was the most lingering symptom, followed by breathing difficulties (4.4%) and lethargy (3.5%). Smell loss or an altered sense of smell was noticed in 1.6% of people, and an altered taste was found in 1.0% of people. Some people also registered multiple symptoms. A proportion of 5.1% of patients had lung effects on their CT scan images, even one year after their release from the hospital. After one year of being released from the hospital, 9.8% of the patients continued to visit health facilities for COVID-19-related issues. The survey involved 693 hospitalized COVID-19 patients in all. These patients were admitted to hospitals when the Delta wave started (not over) in Japan. The survey was done between September 2020 and July 2021. As shown in Fig. 3, the patients who had infection when Delta wave included had more severe symptoms than those who were infected when the Delta wave did not hit Japan. Fig. 3 compares the symptoms of hospitalized patients infected with Wuhan and Wuhan plus delta waves. The latter symptoms were more severe.

According to a Keio University (Japan) study [29], 36.1% of patients who had oxygen support experienced some long-term effects, while the proportion of patients who did not need oxygen remained low at 31.8%. The most prevalent issue was fatigue (13%) followed by difficulties with breathing, muscle loss, and concentration issues at 9%, 8%, and 8%, respectively. Professor Koichi Fukunaga of the above university led the research. A questionnaire was sent out to 1,200 individuals aged 18 years or older who were receiving medical care in hospitals in Japan between January 2020 and February 2021, when the Original Wuhan wave hit the country. The data consisted of the first three waves, excluding the Omicron and Delta waves. It was the first study on the aftereffects of COVID-19 outbreak in Japan.

C. Decay of Long COVID Symptoms in 3, 6, 9, and 12 Months

Fig. 4 shows the decay (improvement) [29] pattern of patients' symptoms over three, six, nine, and twelve months who received either or all of these: oxygen support, ventilators, intensive care. Based on the data shown in Fig. 4, the following analysis can be made. All symptoms decreased by half between three and six months. With the exception of sleep difficulties, which increased by 2.5% between nine and twelve months, all symptoms improved over time. Difficulty in thinking did not improve from nine to twelve months. Muscle pain also did not reduce from six months to nine months. Over six, nine, and twelve months, there was a steady decrease in coughing. Overall, as time passed from three months to twelve months, patients' symptoms decreased, as shown by the bars in Fig. 4. The research was presented at the Japan Respiratory Society, meeting on June 1, 2022, and was conducted by Akihito Yokoyama at Kochi University (Japan).

D. 4 Non Delta Wave; 65 Sample Size; Smoking and Drinking Habits and Patients under Oxygen or Medical Therapy

Long COVID of a small sample size (65) has been studied [31] in this part. The clinical record of the patients, together with other details, has been shown in Table I. The symptoms of 65 patients who visited Okayama University Hospital (Japan) during non-Delta waves have been discussed. Professor Otsuka led the investigation. To find out how each of the sequelae worsened or improved, the follow-up data of Long COVID patients were examined over a three-month period who visited the clinic. Patients' blood antibody levels were measured to see if they could provide a clue about the progression of sequelae. Among the 65 patients, there were 29 males (44.6%) and 36 females (55.4%). When evaluating the duration and types of Post COVID symptoms, patients' vaccination records were taken into account. The median age of patients was 39 years. Between February and July 2021, Okayama University Hospital (Japan) examined the COVID-19 patients’ sequelae data. The infections were recorded during the first four non-Delta waves and the start of the Delta wave, but the whole Delta wave was not included in the study. Despite ending the acute phase of the SARS-CoV-2 infection, about one-third of the patients kept showing symptoms related to COVID-19. Patients whose symptoms persisted for at least one month after the onset of the infection were included in the study. After the first outpatient visit, the study followed up for three months. Whether SARS-CoV-2...
antibody titers were related to longevity and the type of symptom were also investigated. More than 20 diverse aftereffects were observed. The most frequent symptoms were general malaise (discomfort), dysosmia (altered smell), dysgeusia (bad mouth taste), insomnia (sleeplessness), and headache. After three months, symptoms decayed (improved) in about 60% of patients. Antibody titers were higher in patients with severe conditions who were hospitalized and needed oxygen support or had dexamethasone therapy. It was found that patients or individuals whose antibody titers were ≥200 U/mL did not improve in one month, however, they improved in three months.

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<th>TABLE I: STATUS AND DETAILS OF THE PATIENTS WHO VISITED THE COVID-19 AFTER CARE OPC (OUTPATIENT CLINIC)</th>
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<td>Sample size (total patients)</td>
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<td>Male</td>
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<tr>
<td>Female</td>
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<tr>
<td>Median Age (years)</td>
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<tr>
<td>Smoking habit</td>
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<td>Alcohol drinking habit</td>
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<td>Admitted due to COVID-19</td>
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<td>Smoking habit</td>
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<td>Duration after the onset of the infection and clinic visit (median)</td>
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<td>Severity of the COVID-19 infection</td>
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<td>Study period</td>
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<td>Follow-up period of the patients</td>
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<td>Mode of collecting symptoms/listening to the patients</td>
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The number of patients who visited hospitals in the first month was higher for those who were moderately or severely ill and hospitalized for oxygen requirement or corticosteroid therapy. More than half of the patients had recovered from the five most prevalent sequelae (headache, sleeplessness (insomnia), dysosmia (changed smell), dysgeusia (altered mouth taste), and general malaise (discomfort)) three months after their first visit. Fig. 5 depicts % of patients with the aforementioned symptoms. The most common, medium, and less common symptoms were separated as shown in the figure. Fig. 6 shows the gender-wise improvement in symptoms (symptoms’ decay) over time. Improvement in symptoms was faster among females than males. After one month, symptoms remained in 77% of males, whereas females who complained of symptoms reduced to 55%. After two months and three months of hospital visits, symptoms persisted in 62% and 60% of males, respectively. The percentages of females complaining about health issues were lower, at 52% and 41% after two and three months, respectively. A comparison of the symptoms’ declined by age has been depicted in Fig. 7. Younger patients (<40 years) recovered faster than older patients (>40 years) after one and two months of the onset of the infection. However, after three months of the treatment,
the percentage of the patients still suffered remained nearly the same in both cohorts at 49%. About half of the patients disease. The bars in Fig. 8 represent the overall reduction in had symptoms even after three months of developing the symptoms over time. The data are from the same study as stated in the section above (Section III D and Figs. 5, 6, and 7). After one month from the initial hospital visit, only 63% of the patients (calculated across all ages and genders) reported symptoms. After two and three months, 56% and 50% of the individuals still complained of symptoms, respectively.

Fig. 9 compares a decrease (decay) in overall symptoms during the Omicron and the first four non-Delta waves that hit Japan. The blue plot and data are the same as those described in Section III A, when the Omicron lineage was prevalent. As discussed in this section (III D) (Fig. 8), the red plot shows the data of the initial four non-Delta waves. The data covered four waves and the period until the Delta wave began (not completed). Within ten days of infection with the Omicron variant (blue plot), almost half (48%) of the patients had symptoms that decreased to just 5% (5.2%) after 30 days. After two months, only 4% (3.7%) of the individuals had symptoms. On the other hand, after 73 days of contracting the disease, during the initial four non-Delta waves, of the individuals who visited the hospital due to moderate or severe symptoms, 63% still had symptoms after 30 days (red plot). In 60 and 90 days, 56% and 49% of the participants still had health issues, respectively. After one month, 43% of Omicron-infected individuals recovered, compared to 37% of those infected in the initial four waves. The decline in symptoms was faster in the first month for both lineages. Recovery was slower in the following two months, with a 1% decrease in Omicron and a 7% decrease in the first four non-Delta waves that hit Japan. Omicron-infected patients showed milder symptoms after two months (4%), compared to the first four non-Delta-infected individuals (49%) who still suffered aftereffects even after more than five months (163 days). People infected with Omicron recovered faster and at a higher percentage than people infected in the first four non-Delta waves. This is because the Omicron variant is not severe. Also, in the initial four waves, the patients surveyed were mostly hospitalized due to moderate-to-severe symptoms and had more underlying health issues.

IV. CONCLUSIONS

According to a study conducted by Osaka University and Toyonaka City (Japan), around 5% of COVID-19-infected individuals experience symptoms after one month of infection. The majority (77.3%) of surveyed Toyonaka residents were infected with the Omicron variant and stayed in self-isolation at home. About 48% of respondents experienced symptoms after 10 days, but this proportion dropped to 5% after one month and 4% after two months. The likelihood of experiencing aftereffects was 5.4 times higher for those with severe symptoms compared to those who had mild symptoms. Vaccination reduces the risk of developing Post COVID symptoms. The most common symptoms of Long COVID were difficulty in daily life, hair loss, coughing, fever, and altered senses of smell and taste. A study conducted at Kochi University (Japan) found that 14% of patients who were hospitalized for moderate to severe symptoms reported Long COVID one year after discharge. Hospitalized patients with pneumonia and breathing difficulties required oxygen support, ventilator, and intensive care treatment. The study found that COVID-19 patients often suffer from muscle loss, respiratory issues, and fatigue, as well as lung abnormalities caused by interstitial pneumonia. In a report submitted to the Japanese Ministry of Health, Labor, and Welfare, 10% of hospitalized COVID-19 patients continued to suffer from Post COVID symptoms one year after leaving the hospital. Individuals who were infected prior to the Delta wave were surveyed. Decreased muscle strength was the most persistent symptom (7.4%), followed by breathing difficulties (4.4%) and lethargy (3.5%).

As revealed by the CT scan images, 5.1% of the patients had lung effects. Keio University (Japan) conducted a study that found that 36.1% of patients who needed oxygen support experienced long-term effects, compared to only 31.8% of those who were not on oxygen support. The most commonly reported symptoms were fatigue (13%), breathing problems (9%), muscle loss (8%), and difficulty concentrating (8%). The study was led by Professor Koichi Fukunaga, who examined the aftereffects of COVID-19 in Japan for the first time. Professor Koichi Fukunaga led the research, it was the first such study on COVID-19 aftereffects in Japan. It covered the period from January 2020 to February 2021, when the original Wuhan variant hit Japan.
STATEMENTS

No experiments on animals or in the laboratory were conducted at our research center. The author, Zameer Shervani (ZS), Ph.D., is the Director General of the Food & Energy Security Research & Product Center located in Sendai, Japan. The article's copyrights belong to the corresponding author (ZS). Co-authors worked online. Authors have qualifications: Deepali Bhardwaj MBBS, MD, DVL-D, M.Phil.; Muhammad Jahenzeb Khan Ph.D.; Venkata Phani Sai Reddy Vuyyuru MBBS; Adil Ahmed Khan MBBS; Parangimalai Diwakar Madan Kumar BDS, MDS; Aisha Mahmood MBBS.

CONFLICT OF INTEREST

There is no conflict of interest in this paper.

REFERENCES


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