ENT Symptoms in Post-COVID Infection of Health Care Workers at Venerable Thawisak Jutindharo Hospital

Pecharat Aiempongpaiboon, MD[1]

[1] Department of Otorhinolaryngology, Venerable Thawisak Jutindharo Hospital, Bangkok, Thailand

Objective: To determine the incidence, duration, and factors associated with ENT symptoms according to COVID-19 among healthcare workers at Venerable Thawisak Jutindharo Hospital.

Materials and Methods: A cross-sectional study was conducted on the healthcare workers whose PCR and ATK nasopharyngeal swabs were positive for COVID-19. All patients were employed at Venerable Thawisak Jutindharo Hospital in Bangkok, Thailand, between January 1 and October 31, 2022. Demographic data and clinical manifestations were collected. Descriptive statistics were performed, followed by Chi-square and multiple logistic regressions to determine associated factors for ENT symptoms according to COVID-19.

Results: Two hundred and ten cases were included. Most of them were females with 167 cases (79.5%). Cough was the most common presenting symptom at 81.8%. After acute phase, 147 cases (70%) of post-COVID-19 ENT symptoms were reported. Subgroup analysis was conducted based on symptomatology and showed laryngological symptoms in 63.8%, followed by rhinological symptoms in 25.7%, and otological symptoms in 6.6%. Most symptoms were recovered within four weeks after the infection. Some lasted more than twelve weeks, such as cough in seven cases, sore throat in two cases, and rhinorrhea in one case. The patients recovered from all symptoms by week 13. The risk associated with increasing post-COVID-19 ENT symptoms was age. Age less than fifty years had a significantly higher risk of post-COVID-19 ENT symptoms than age greater than fifty years (adjusted OR 2.33, 95% CI 1.08 to 5.00).

Conclusion: Cough was the most common ENT symptom in early and post-COVID infection period. Most cases recovered within four weeks after infection. Age was the key factor that causes ENT symptoms in COVID-19. Antiviral drug, severity of COVID infection, and other factors do not result in post-COVID ENT symptom.

Keywords: Post-COVID infection; Post-COVID ENT symptom; Healthcare worker

COVID-19 is an infectious disease that originated in Wuhan, China, and the outbreak first known case was in December 2019. The World Health Organization (WHO) officially designated the global COVID-19 outbreak as a pandemic on March 11, 2020. Studies have shown that the most common symptoms were fever, fatigue, dry cough, and runny nose[1-4]. However, a study in three centers in different regions of Saudi Arabia found that the initial symptoms of ENT were sore throat, anosmia, and loss of taste[5].

Post-COVID infection was a significant issue in the COVID-19 pandemic. However, the exact pathophysiological mechanism of post-COVID-19 is still unclear. Researchers and clinicians have proposed numerous general pathophysiological mechanisms for post-COVID-19 syndrome based on disease severity, virus-affected organs, immunological abnormalities, inflammatory damage, virus-specific pathophysiological changes, and oxidative stress[6]. Studies reported long-term COVID-19 effects on various systems, including respiratory, cardiovascular, gastrointestinal, neurological, and psychiatric manifestations. Residual symptoms were affecting the quality of life.

A systematic review of 23 studies of the long-term consequences of COVID-19 found that persistent respiratory symptoms, fatigue, and decreased quality of life occurred up to six months after infection[7]. In addition, a systematic review of 145 studies showed that 24.13% of reports of long-term COVID-19 symptoms involved neurologic

Correspondence to:

Aiempongpaiboon P.

Department of Otorhinolaryngology, Venerable Thawisak Jutindharo Hospital, 6 Nong Khaem-Wat Sri Nuan 1 Road, Nong Khaem Subdistrict, Nong Khaem, Bangkok 10160, Thailand.

Phone: +66-2-4293575 to 81, +66-86-7505222

Email: Pecharat019@gmail.com

complaints and olfactory disturbances, and 55.17% involved specific widespread symptoms, mainly chronic fatigue, and pain[8,9].

Healthcare workers (HCWs) are critical in the initial response to the COVID-19 pandemic because they are more susceptible to infection. Because of their close contact with highly infected patients and contact with undiagnosed or subclinically infected cases, HCWs are at increased risk for COVID-19 infection. Most HCWs were vaccinated before the general population. Studies have examined the epidemiology and risk factors for COVID-19 infection in HCW or the general population, but there is no study on the long-term effects.

The present study aimed to determine the incidence, role of vaccination, antiviral drugs, and other factors associated with post-COVID ENT symptoms in HCW at Venerable Thawisak Jutindharo Hospital following COVID-19 infection.

Materials and Methods

The present research was a cross-sectional study. Data were collected from the HCWs at Venerable Thawisak Jutindharo Hospital between January and October 2022, targeted those infected with COVID-19 by an ATK diagnosis or RT-PCR for SARCoV positive.

Post-COVID infection data in the present research were collected from the patients already been infected after two weeks. According to the Centers for Disease Control and Prevention (CDC), COVID-19 symptoms may appear anywhere from two to fourteen days after exposure to the virus[10]. The present study was based on a face-to-face interview in the ENT outpatient department. The first section included the demographic characteristics of the patients. The second section includes clinical data, such as the initial symptom, duration, other symptoms, long-term ENT symptoms, the ENT symptoms persisting for more than two weeks, or the new ENT symptoms occurring after the first two weeks. In the present study, the symptoms of the COVID infection were subjective. They varied depending on the condition of the patients. They detailed the rhinological, laryngological, and otological findings that occurred or persisted in the acute phase.

All data were entered into the IBM SPSS Statistics, version 26.0 (IBM Corp., Armonk, NY, USA) concurrent license (Research and Medicine Center, Medical Service Department, Bangkok Metropolitan Administration). The present study was approved by the Bangkok Research Ethics Committee for Research Involving Human Subjects (EC number S019h/65_EXP). Descriptive analysis was performed for demographic and clinical data. Analysis was performed to assess the association between the variables of interest and post-COVID ENT symptoms using the chi-square test, and a p-value less than 0.05 was considered statistically significant. In addition, the study applied binary logistic regression in both univariate analysis and multivariate analysis methods. Firstly, the univariate analysis was carried out with independent variables, one at a time. When the p-value was less than 0.10, the next step was multivariate analysis. In the later analysis, several independent variables with significance were addressed. Then the selected variables were examined at the same time.

Results
Demographic data

Two hundred ten COVID-19-positive patients were enrolled in the present study. Most of them were female at 79.5%, while 43 (20.5%) were male. The age range of the patients was 20 to 59 years old while the mean age was 39.1±9.19 years. One hundred seventy-four cases (82.8%) were in the under 50 years group, 36 cases (17.15%) were in the over 50 years group, and 19 cases (12.9%) in the over 50 years group, had symptoms according to ENT COVID, as shown in Table 1.

Most patients (63.8%) had no underlying disease. For underlying diseases, the result showed 22 cases had hypertension, which accounted for 28.9%. There were 18 cases of hyperlipidemia (23.7%), allergic rhinitis presented in 17 cases (22.36%), 11 cases (14.47%) had diabetes mellitus, and other diseases such as heart disease, hyperthyroidism, gout, and fatty liver. The average body mass index (BMI) was 24.85 (±SD 4.92). Of the 210 cases, non-smokers were 187 cases (89.1%), whereas smokers were 23 cases (16.1%). The severity of patients in the acute phase of the disease were mild in 166 cases (79.1%), moderate in 24 cases (16.3%), asymptomatic in eight cases (3.8%), and none had severe symptoms. All patients were vaccinated with COVID vaccines. Most patients received four doses of COVID vaccine. The antiviral drugs in the present study were favipiravir in 79 cases (37.6%), molnupiravir in 53 cases (25.2%), other drugs in 9.5%, and 54 cases (25.7%) received no antiviral drug.

Clinical features

Symptoms in the acute phase were cough in

Table 1. Baseline and clinical characteristics in post-COVID infection of healthcare workers

Variable	ENT symptom (n=147); n (%)	No ENT symptom (n=63); n (%)	p-value
Age (years)			0.013*
Less than 50	128 (87.1)	46 (73.0)	
More than 50	19 (12.9)	17 (27.0)	
Sex			0.057
Male	25 (17.0)	18 (28.6)	
Female	122 (83.0)	45 (71.4)	
Underlying disease			0.573
No	92 (62.6)	42 (66.7)	
Yes	55 (37.4)	21 (33.3)	
BMI			0.123
<18.5	7 (4.8)	1 (1.6)	
18.5 to 22.99	60 (40.8)	21 (33.3)	
23 to 24.99	16 (10.9)	14 (22.2)	
≥25	64 (43.5)	27 (42.9)	
Smoke			
No	134 (91.2)	53 (84.1)	0.135
Yes	13 (8.8)	10 (15.9)	
Severity of disease			0.632
Asymptomatic-mild	123 (83.7)	51 (81.0)	
Moderate	24 (16.3)	12 (19.0)	
Antiviral drug			0.828
No	36 (24.5)	18 (28.6)	
Andrographis	7 (4.8)	4 (6.3)	
Favipiravir	55 (37.4)	24 (38.1)	
Molnupiravir	38 (25.9)	15 (23.8)	
Paxlovid	8 (5.4)	1 (1.6)	
More than one	3 (2.0)	1 (1.6)	
Vaccination (dose)			0.989
1 to 3	27 (18.4)	12 (19.0)	
4	72 (49.0)	31 (49.2)	
5 to 6	48 (32.7)	20 (31.7)	

BMI=body mass index

* p<0.05, statistical significance

171 cases (81.8%) and fever in 134 cases (63.8%), rhinorrhea in 113 cases (53.8%), loss of smell in 25 cases (11.9%), loss of taste in 20 cases (9.5%), and diarrhea in 16 cases (7.6%). Two hundred and ten patients were recruited for the present study while ENT symptoms after the acute phase contained 147 patients (70%). The patients of 134 cases (63.8%) had laryngologic symptoms, followed by rhinologic symptoms in 54 cases (25.7%), and otologic symptoms in 14 cases (6.6%). Some patients had more than one symptom.

Regarding laryngologic symptoms, cough was the most common symptom after COVID. One hundred nineteen patients (56.7%) of the patients coughed after the acute phase, and seven patients (3.3%) had the symptom for more than 12 weeks. Sore throat was the second most common symptom in 79 cases (37.6%), and two patients (0.9%) had the symptom for more than 12 weeks. Most patients recovered within four weeks of COVID-19 infection, and all patients with symptoms longer than 12 weeks recovered by week 13. Another symptom was hoarseness in 37 cases (17.6%) and dysphagia in four cases (1.9%). These patients recovered within five weeks of the infection.

As for rhinological symptoms, rhinorrhea was the most common symptom after COVID. Thirty-eight patients (18%) had rhinorrhea after the acute phase and only one person had the symptom for more than 12 weeks. The duration of recovery averaged ten days after the acute phase. The second most common symptom was nasal congestion. Twenty-eight people had nasal congestion after the acute phase, and six patients had the symptoms for up to five weeks. The duration to recovery was, on average, eleven days after the acute phase. Other symptoms were dysgeusia in 12 cases and hyposmia in ten cases. The recovery duration for both symptoms averaged seven days after the acute phase.

The otological symptoms, vertigo and dizziness were the only symptoms with an incidence of 14 patients (6.7%). The duration of recovery averaged three days after the acute phase.

Factors associated with ENT symptoms in post-COVID infection of HCW

The result showed no statistically significant differences in multivariable analyses between symptoms after ENT infection, such as gender, underlying disease, BMI, severity of acute COVID infection, antiviral medication, and vaccination history. After multivariable analysis using logistic regression and accounting for BMI, gender, and antiviral medication, it was found that the age group under 50 years (adjusted OR 2.33, 95% CI 1.08 to 5) was the only variable associated with symptoms as post-COVID ENT as shown in Table 2.

For subgroup analysis, the study was divided into three groups of symptoms according to COVID ENT, with laryngological, rhinological, and otological symptoms.

Regarding laryngology, the age group less than 50 years increased the risk of post-COVID laryngological symptoms (adjusted OR 3.26, 95% CI 1.53 to 6.97), as shown in Table 3.

Table 2. Univariable and multivariable binary logistic model to determine the association of predictors in participants with ENT outcome

	ENT symptom; n (%)		Univariate		Multivariate	
	Yes (n=147)	No (n=63)	OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (year)						
Less than 50	128 (87.1)	46 (73.0)	2.49 (1.19 to 5.2)	0.015*	2.33 (1.08 to 5)	0.031*
More than 50	19 (12.9)	17 (27.0)	Reference	1	Reference	1
BMI						
<18.5	7 (4.8)	1 (1.6)	2.45 (0.28 to 21.1)	0.415	2.05 (0.24 to 17.8)	0.514
18.5 to 22.99	60 (40.8)	21 (33.3)	Reference	1	Reference	1
23 to 24.99	16 (10.9)	14 (22.2)	0.4 (0.17 to 0.96)	0.04*	0.45 (0.18 to 1.1)	0.08
≥25	64 (43.5)	27 (42.9)	0.83 (0.42 to 1.62)	0.585	0.99 (0.49 to 1.98)	0.967
Antiviral drug						
No	36 (24.5)	18 (28.6)	Reference			
Andrographis	7 (4.8)	4 (6.3)	0.88 (0.23 to 3.38)			
Favipiravir	55 (37.4)	24 (38.1)	1.15 (0.55 to 2.41)			
Molnupiravir	38 (25.9)	15 (23.8)	1.27 (0.56 to 2.88)			
Paxlovid	8 (5.4)	1 (1.6)	4 (0.46 to 34.49)			
More than one	3 (2.0)	1 (1.6)	1.5 (0.15 to 15.46)			
Sex						
Male	25 (17.0)	18 (28.6)	Reference	1	Reference	1
Female	122 (83.0)	45 (71.4)	1.95 (0.97 to 3.91)	0.06	1.58 (0.76 to 3.27)	0.22

BMI=body mass index; OR=odds ratio; CI=confidence interval

* p<0.05, statistical significance

Table 3. Univariable and multivariable binary logistic model to determine the association of predictors in participants with post-COVID laryngological symptoms

	Laryngological symptom; n (%)		Univariate		Multivariate	
	Yes (n=134)	No (n=76)	OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (year)						
Less than 50	120 (89.6)	54 (71.1)	3.49 (1.66 to 7.34)	0.001*	3.26 (1.53 to 6.97)	0.002*
More than 50	14 (10.4)	22 (28.9)	Reference	1	Reference	1
BMI						
<18.5	7 (5.2)	1 (1.3)	2.95 (0.34 to 25.27)	0.324	2.53 (0.29 to 21.82)	0.398
18.5 to 22.99	57 (42.5)	24 (31.6)	Reference	1	Reference	1
23 to 24.99	15 (11.2)	15 (19.7)	0.42 (0.18 to 1)	0.049*	0.44 (0.18 to 1.05)	0.063
≥25	55 (41)	36 (47.4)	0.64 (0.34 to 1.21)	0.174	0.75 (0.39 to 1.44)	0.384
Antiviral drug						
No	35 (26.1)	19 (25.0)	Reference	1		
Andrographis	7 (5.2)	4 (5.3)	0.95 (0.25 to 3.66)	0.941		
Favipiravir	50 (37.3)	29 (38.2)	0.94 (0.45 to 1.93)	0.857		
Molnupiravir	33 (24.6)	20 (26.3)	0.9 (0.41 to 1.97)	0.784		
Paxlovid	7 (5.2)	2 (2.6)	1.9 (0.36 to 10.07)	0.451		
More than one	2 (1.5)	2 (2.6)	0.54 (0.07 to 4.17)	0.557		

BMI=body mass index; OR=odds ratio; CI=confidence interval

* p<0.05, statistical significance

Concerning rhinology, underlying disease, and dysgeusia increased the odds of post-COVID-19 rhinological symptoms 2.48-fold (adjusted OR 2.48, 95% CI 1.24 to 4.93) and 3.91-fold (adjusted OR 3.91, 95% CI 1.14 to 13.39), respectively. Booster vaccination with the fifth and sixth dose reduced the risk of rhinitis-related symptoms (adjusted OR 0.31, 95% CI 0.12 to 0.85), as shown in Table 4.

Table 4. Univariable and multivariable binary logistic model to determine the association of predictors in participants with post-COVID rhinological symptoms

	Rhinological symptom; n (%)		Univariate		Multivariate	
	Yes (n=54)	No (n=156)	OR (95%CI)	p-value	Adjusted OR (95% CI)	p-value
Underlying disease						
No	28 (51.9)	106 (67.9)	Reference	1	Reference	1
Yes	26 (48.1)	50 (32.1)	1.97 (1.05 to 3.7)	0.035*	2.48 (1.24 to 4.93)	0.01*
Rhinorrhe						
No	19 (35.2)	78 (50.0)	Reference	1	Reference	1
Yes	35 (64.8)	78 (50.0)	1.84 (0.97 to 3.5)	0.062	1.6 (0.81 to 3.18)	0.177
Loss of smell						
No	43 (79.6)	142 (91)	Reference	1	Reference	1
Yes	11 (20.4)	14 (9)	2.59 (1.1 to 6.13)	0.03*	1.26 (0.39 to 4.08)	0.701
Loss of taste						
No	43 (79.6)	147 (94.2)	Reference	1	Reference	1
Yes	11 (20.4)	9 (5.8)	4.18 (1.63 to 10.74)	0.003*	3.91 (1.14 to 13.39)	0.03*
Antiviral drug						
No	11 (20.4)	43 (27.6)	Reference	1		
Andrographis	3 (5.6)	8 (5.1)	1.47 (0.33 to 6.46)	0.613		
Favipiravir	20 (37.0)	59 (37.8)	1.33 (0.58 to 3.05)	0.508		
Molnupiravir	16 (29.6)	37 (23.7)	1.69 (0.7 to 4.09)	0.245		
Paxlovid	3 (5.6)	6 (3.8)	1.95 (0.42 to 9.08)	0.392		
More than one	1 (1.9)	3 (1.9)	1.3 (0.12 to 13.77)	0.826		
Vaccination dose						
1 to 3	13 (24.1)	26 (16.7)	Reference	1	Reference	1
4	30 (55.6)	73 (46.8)	0.82 (0.37 to 1.81)	0.627	0.64 (0.27 to 1.52)	0.314
5 to 6	11 (20.4)	57 (36.5)	0.39 (0.15 to 0.98)	0.044*	0.31 (0.12 to 0.85)	0.023*

OR=odds ratio; CI=confidence interval

* p<0.05, statistical significance

For otology-related symptoms, smoking increased the odds of post-COVID rhinological symptoms by 4.23-fold (adjusted OR 4.23, 95% CI 1.07 to 16.71). Booster vaccinations (adjusted OR 0.24, 95% CI 0.08 to 0.77) reduced the risk of post-COVID otology-related symptoms as shown in Table 5.

Discussion

The COVID-19 pandemic still has a significant disruptive effect on the world economy due to the appearance of new strains and other causes. The discussions detail the ENT symptoms after infection and are divided into three categories, laryngological, otological and rhinological infection.

Previous studies discussed multiple organ systems and the wide range of the ages[11]. Kumar et al. (2022) reported the post-COVID symptoms were dyspnea, fatigue, and mental health issues that did not concentrate on the HCWs[12]. The aim of the present study was to focus on the HCW group. The

reasons for the HCW group selection were firstly the determination of the age range of 20 to 59 years olds of the samples. In addition, the group has extensive knowledge on public health that could precisely and accurately explain their symptoms.

In the present study, the most common symptoms in COVID-19 patients were cough at 81.8%, followed by fever at 63.8%. The results of the present study were similar to those of previous systematic reviews and meta-analysis studies[8], which reported that cough occurred in 57% of patients, the median time between onset of illness and cough was one day, and cough persisted for an average of 19 days. Cough persisted until four weeks after infection or longer in about 5% of patients[13].

The long-term effects of COVID-19 on ENT symptoms were the laryngological symptoms that appeared to be most affected. Cough was the most common complaint at 56.7%, while sore throat accounted for 37.6%, and hoarseness 17.6%. Otological symptoms were less common in the long

Table 5. Univariable and multivariable binary logistic model to determine the association of predictors in participants with post-COVID otological symptoms

	Otological symptom; n (%)		Univariate		Multivariate	
	Yes (n=14)	No (n=196)	OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Smoke						
No	10 (71.4)	177 (90.3)	Reference	1	Reference	1
Yes	4 (28.6)	19 (9.7)	3.73 (1.07 to 13.04)	0.04*	4.23 (1.07 to 16.71)	0.04*
Antiviral drug						
No	4 (28.6)	50 (25.5)	Reference	1		
Andrographis	2 (14.3)	9 (4.6)	2.78 (0.44 to 17.49)	0.276		
Favipiravir	2 (14.3)	77 (39.3)	0.32 (0.06 to 1.84)	0.204		
Molnupiravir	3 (21.4)	50 (25.5)	0.75 (0.16 to 3.52)	0.716		
Paxlovid	2 (14.3)	7 (3.6)	3.57 (0.55 to 23.23)	0.183		
More than one	1 (7.1)	3 (1.5)	4.17 (0.35 to 49.84)	0.26		
Vaccination dose						
1 to 3	8 (57.1)	31 (15.8)	Reference	1	Reference	1
4	6 (42.9)	97 (49.5)	0.24 (0.08 to 0.74)	0.013*	0.24 (0.08 to 0.77)	0.016*
5 to 6	0 (0.0)	68 (34.7)	N/A	N/A	N/A	N/A

OR=odds ratio; CI=confidence interval; N/A=not applicable

* $p<0.05$, statistical significance

term after the acute phase of infection. Vertigo was reported by only 6.7%. The result of the present study contrasted with the previous studies[14] in which vertigo was reported as a common post-COVID ENT symptom.

The only risk factor associated with symptoms of post-COVID-19 ENT was an age of less than 50 years in this study. There is a decline in pathogen immunity when the age increased as younger patients had a more robust immune response than older patient[15]. That is why younger age patients have more symptoms than the older age. Several factors contribute to the pathophysiology of post-COVID-19 syndrome, including oxidative stress, immunologic abnormalities, and inflammatory injury[6].

COVID-19 vaccination has been shown to provide safe and effective protection against SARS-CoV-2 infection and reduce the severity of acute COVID-19[16,17]. Most HCWs received over four doses of the vaccines from at least one dose of AztraZeneca or that of Pfizer. So, the severity of acute symptoms possibly decreased after COVID infection. In this case, the patients who received more than four doses of the vaccine may prevent rhinological and otological symptoms after COVID infection. Interestingly, in the present study, there was no statistically significant difference between the occurrence of symptoms for post-COVID ENT in patients who had or had not received an antiviral drug while the drug reduces the morbidity rate. In contrast,

from the previous studies, Choi et al. (2023) reported that antiviral drug reduced risk of post-COVID infection and related hospitalization or death[18].

The study concluded that the benefit of at least four vaccination is the reduction of rhinological and otological symptoms in post-COVID ENT. This determines the number of vaccines that people should have. However, the limitation of the study is the samples were selected from HCWs. Therefore, further study should be extended to other age groups to compare results in elderly patients.

Conclusion

Cough was the most common ENT symptom both acute and post-COVID infection, which recovered within four weeks after infection. Age was a factor associated with ENT symptoms of COVID-19. Antiviral drug and severity of COVID infection were not associated.

What is already known on this topic?

HCWs who received at least four doses of the COVID vaccine had no severe symptoms in the acute phase, reduced rhinological and otological symptoms in post-COVID ENT, and should be extended to other age groups to compare results in elderly patients.

What does this study add?

There is no difference in post-COVID ENT symptoms in patients who have received an antiviral

drug and those who have not received an antiviral drug.

Acknowledgement

Conflicts of interest

The authors declare no conflict of interest.

References

1. Hu B, Guo H, Zhou P, Shi ZL. Characteristics of SARS-CoV-2 and COVID-19. Nat Rev Microbiol 2021;19:141-54.

2. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395:507-13.

3. Bhatta S, Gandhi S, Saindani SJ, Ganesuni D, Ghanpur AD. Otorhinolaryngological manifestations of coronavirus disease 2019: a prospective review of 600 patients. J Laryngol Otol 2021;135:206-11.

4. Alrusayyis D, Aljubran H, Alshaibani A, Alsharhan S, AlSaied A, AlEnazi A, et al. Patterns of otorhinolaryngological manifestations of Covid-19: A longitudinal questionnaire-based prospective study in a tertiary hospital in Saudi Arabia. J Prim Care Community Health 2022;13:21501319221084158.

5. Telmesani LM, Althomaly DH, Buohliqah LA, Halawani RT, Ashoor MM, Alwazzeh MJ, et al. Clinical otorhinolaryngological presentation of COVID-19 patients in Saudi Arabia: A multicenter study. Saudi Med J 2022;43:266-74.

6. Pierce JD, Shen Q, Cintron SA, Hiebert JB. Post-COVID-19 syndrome. Nurs Res 2022;71:164-74.

7. Ng WH, Tipih T, Makoah NA, Vermeulen JG, Goedhals D, Sempa JB, et al. Comorbidities in SARS-CoV-2 patients: A systematic review and meta-analysis. mBio 2021;12:e03647-20.

8. Grant MC, Geoghegan L, Arbyn M, Mohammed Z, McGuinness L, Clarke EL, et al. The prevalence of symptoms in 24,410 adults infected by the novel coronavirus (SARS-CoV-2; COVID-19): A systematic review and meta-analysis of 148 studies from 9 countries. PLoS One 2020;15:e0234765.

9. Amin MT, Hasan M, Bhuiya N. Prevalence of Covid-19 associated symptoms, their onset and duration, and variations among different groups of patients in Bangladesh. Front Public Health 2021;9:738352.

10. Welsh J. Centers for Disease Control and Prevention (CDC). COVID-19 incubation period: Average number of days after exposure [Internet]. 2023 [cited 2023 Nov 29]. Available from: https://www.verywellhealth.com/covid-incubation-period-8405031.

11. Bahmer T, Borzikowsky C, Lieb W, Horn A, Krist L, Fricke J, et al. Severity, predictors and clinical correlates of Post-COVID syndrome (PCS) in Germany: A prospective, multi-centre, population-based cohort study. EClinicalMedicine 2022;51:101549.

12. Kumar G, Bhalla A, Mukherjee A, Turuk A, Talukdar A, Mukherjee S, et al. Post COVID sequelae among COVID-19 survivors: insights from the Indian National Clinical Registry for COVID-19. BMJ Glob Health 2023;8:e012245.

13. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020;395:1054-62.

14. Alzahrani M, Alshathri AH, Alduraibi K, Alshathri AH, Alanazi TF, Alandijani H, et al. Long-term outcomes of COVID-19 otolaryngology symptoms in Saudi Arabia. Cureus 2023;15:e33461.

15. Bartleson JM, Radenkovic D, Covarrubias AJ, Furman D, Winer DA, Verdin E. SARS-CoV-2, COVID-19 and the ageing immune system. Nat Aging 2021;1:769-82.

16. Lopez Bernal J, Andrews N, Gower C, Robertson C, Stowe J, Tessier E, et al. Effectiveness of the Pfizer-BioNTech and Oxford-AstraZeneca vaccines on covid-19 related symptoms, hospital admissions, and mortality in older adults in England: test negative case-control study. BMJ 2021;373:n1088.

17. Tofarides AG, Christaki E, Milionis H, Nikolopoulos GK. Effect of vaccination against SARS-CoV-2 on long COVID-19: A narrative review. Life (Basel) 2022;12:2057.

18. Choi Y, Seo Y, Seo JW, Lee J, Nham E, Seong H, et al. Effectiveness of antiviral therapy on long COVID: A systematic review and meta-analysis. J Clin Med 2023;12:7375.