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Characteristics and factors associated with severity of COVID-19 infections in primary care

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Abstract

Introduction: Primary care service plays a vital role in early clinical assessment of patients with COVID-19 in Malaysia. This study aimed to evaluate the potential risk factors of COVID-19 severity at presentation to primary care facilities in the post-vaccination period.

Methods: Clinical records from the Selangkah system of all patients with COVID-19 aged above 18 years seen at COVID-19 assessment centres located in 10 government health clinics in Gombak district, Selangor, from 1 October to 31 December 2021 with complete documentation and outcomes were retrieved. Demographics, comorbidities, clinical features and vaccination statuses and types were retrospectively evaluated. The variables were compared between mild and severe diseases. Univariate and multivariable logistic regressions were used to identify the factors affecting disease severity.

Results: A total of 4406 patients (median age=37 years, men=51.2%) were analysed. Approximately 97.1% of the cases were mild, while 2.9% were severe. Fever, difficulty breathing, lethargy, throat irritation/runny nose, oxygen saturation of <95%, respiratory rate of >20 breaths per minute, CoronaVac vaccination and hypertension were the determinants of severity (P<0.05).

Conclusion: The high proportion (97.1%) of mild cases in this study compared with an earlier report (81.8%) during the pre-vaccination period may suggest the impact of vaccine, as 84.9% of this cohort was fully vaccinated. Our study also demonstrated a significant difference in COVID-19 severity between the vaccine types. The identified clinical features and comorbidities could assist primary care doctors in stratifying patients with COVID-19 judiciously in terms of hospital referral or home quarantine.

Introduction

COVID-19, which began to spread in late 2019, is caused by SARS-CoV-2. This infection has led to high mortality and mortality worldwide. As of 30 September 2022, 614 million people worldwide had been infected with COVID-19, with accumulated 6.5 million deaths.[1] Within a similar period in Malaysia, there had been almost 4.8 million cases of COVID-19 with almost 1% mortality overall.[2]

At the onset of the pandemic, all patients with COVID-19 in Malaysia were admitted to hospitals regardless of disease severity, as the number of patients was still relatively small, and the disease course was still uncertain. As the number of COVID-19 cases continued to grow, patients with mild disease were allowed to quarantine at home. Only those with moderate and severe diseases were admitted. Therefore, COVID-19 assessment centres (CACs) were set up nationwide to act as triaging and early treatment centres before hospital transfer.[3] Almost each district in Malaysia has either at least a large centralised CAC or a smaller CAC that is connected to government health clinics.[4] Such CACs are managed by primary care doctors and paramedics.

Considering the limited healthcare resources in hospitals, especially bed availability, only high-risk patients are admitted. Before the advent of COVID-19 vaccines, many studies, especially those from China, have established the risk factors of severe COVID-19. These risk factors include older age and comorbidities such as chronic hypertension, diabetes mellitus, cardiovascular disease, chronic respiratory disease and cancer.[5,6] However, similar studies in the post-vaccination period are scarce, especially in Asia. Therefore, this study aimed to examine the potential risk factors of COVID-19 severity at presentation to primary care facilities in the post-vaccination period. The findings could assist primary care doctors in

prioritising hospital admission for patients with severe disease seen in primary care levels or CACs, therefore leading to judicious use of limited healthcare resources.

Methods

Study design and data source

This retrospective cross-sectional study was conducted in Gombak district, which is one of the nine districts in Selangor state. All adults aged ≥18 years with COVID-19 seen in CACs located in all 10 government health clinics in Gombak were included (**Figure 1**). In Selangor, most CACs use the Selangkah system for medical documentation for patients with COVID-19. Selangkah was first introduced in May 2020 as an immediate response to facilitate the monitoring of human traffic amid the movement controls resulting from the COVID-19 pandemic. The one-stop system was designed and supported by the Selangor state government. It includes a contact tracing mobile application, clinical documentation website for CACs and daily self-reported assessment for patients with COVID-19. Patients with COVID-19 in the district are registered with the website where they are assessed either virtually or physically and arranged for admission or home quarantine, self-reported daily assessment and release order. The clinical documentation website includes sociodemographic and clinical data such as selection of symptoms, clinical findings, additional documentation and disposition of patients. Specific documentation for the initial assessment is organised in four tabs on the website: patient details, comorbidity and pregnancy, symptoms and vital signs and resolution or management. The system can be accessed only by approved healthcare workers. Patients who are deemed eligible for home quarantine are advised to self-report their symptoms daily. These daily reports are also monitored by healthcare workers of CACs using the website until their quarantine ended.

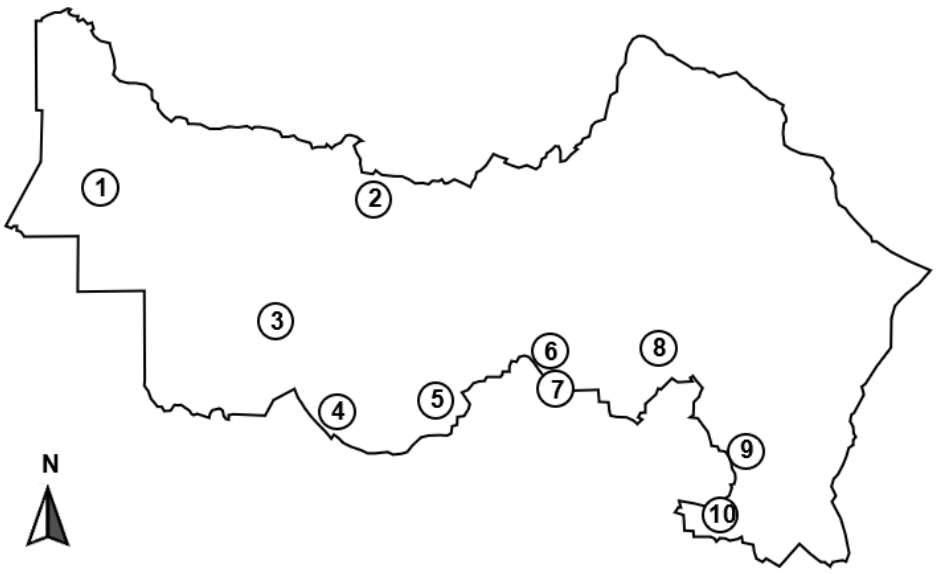

Figure 1. COVID-19 assessment centres of government health clinics in Gombak, Selangor, Malaysia.
1. Klinik Kesihatan Batu Arang; 2. Klinik Kesihatan Kuang; 3. Klinik Kesihatan Rawang; 4. Klinik Kesihatan Sungai Buloh; 5. Klinik Kesihatan Taman Ehsan; 6. Klinik Kesihatan Selayang Baru; 7. Klinik Kesihatan Gombak Setia; 8. Klinik Kesihatan Batu 8 Gombak; 9. Klinik Kesihatan Hulu Kelang; 10. Klinik Kesihatan AU2

Since the data on the final COVID-19 severity were not available, as patients may present to the hospital on their own, only data during the first physical visit to the CACs for assessment were used for data analysis in this study. Patients aged <18 years and those who came for reassessment and virtual visits were excluded from the study. Conversely, patients who were seen from 1 October to 31 December 2021 were included. This period was selected because the vaccination status and type were first included in the Selangkah system on 17 September 2021.

According to the guidelines from the Ministry of Health Malaysia, COVID-19 was confirmed with positive findings of either real-time reverse transcription polymerase chain reaction using nasopharyngeal and oropharyngeal swabs, rapid antigen test kit using nasopharyngeal swabs or self-saliva rapid antigen test kit. The COVID-19 severity was based on the COVID-19 Management Guideline in Malaysia by the Ministry of Health.7 Each case was categorised according to clinical severity: stage 1: asymptomatic, stage 2: symptomatic without pneumonia, stage 3: symptomatic with pneumonia, stage 4: symptomatic with pneumonia requiring supplemental oxygen and stage 5: critically ill with multi-organ failure. Stages 1 and 2 were considered mild, while stages 3 to 5 were considered severe.

Statistical analysis

The data were analysed using IBM SPSS version 26 for Windows (IBM, USA). The patient data were de-identified and analysed as a cohort. There was <5% missing data in the dataset, and further analysis showed that the data were missing completely at random and therefore do not lend bias to the observed data. However, the missing data were treated with listwise deletion in subsequent analyses. The data were summarised using numbers and percentages. Difference between groups was analysed using the chi-square test or Fisher's exact test, as appropriate. To determine the independent risk factors of COVID-19 severity, we performed a multivariable logistic regression analysis with COVID-19 severity as the dependent variable. To reduce the number of variables included in the multivariable model, we used a simultaneous entry method with an inclusion criterion of P<0.05. Collinearity between variables was ruled out before covariates were introduced in the final model. The Hosmer–Lemeshow test was used to evaluate goodness-of-fit, and odds ratios with 95% confidence intervals (CIs) were computed. All P-values reported were two-sided, and P<0.05 was considered statistically significant.

Results

During the study period, 4406 patients presented to the CACs in primary care facilities for initial assessment. Of them, 4277 (97.1%) were diagnosed with mild disease and 129 (2.9%) with severe disease (**Figure 2**).

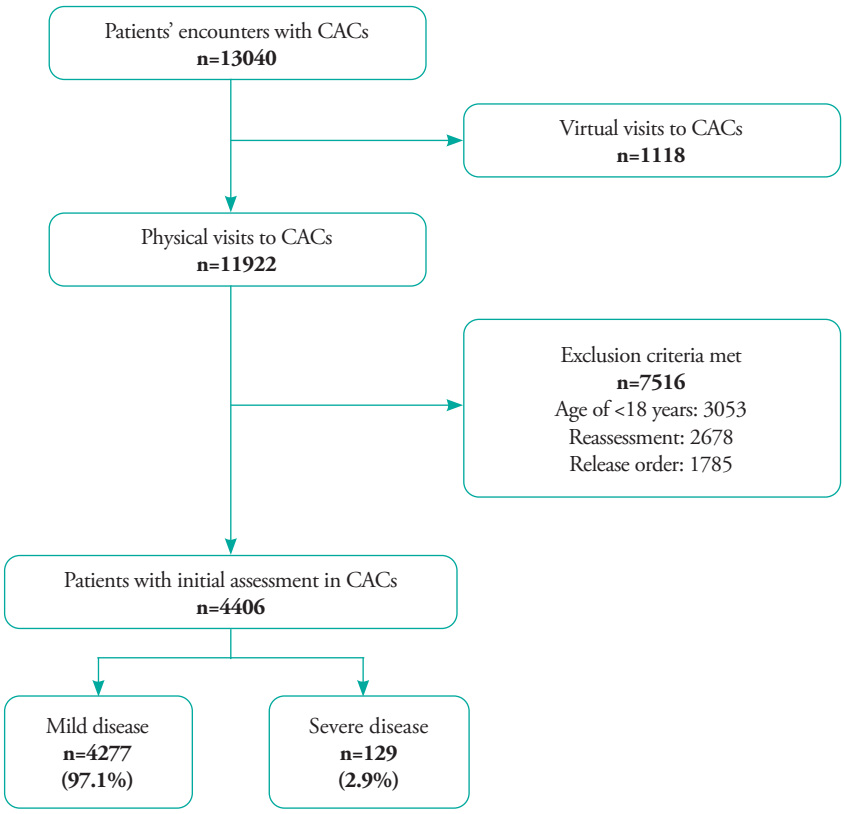

Figure 2. Flow diagram of patient inclusion in the study.
CAC, COVID-19 assessment centre

The median patient age was 37 years (interquartile range=21). Most (87.0%) patients were aged from 18 to 59 years. The male (51.2%) and female (48.8%) patients were distributed almost equally. Almost all patients were Malaysian (99.0%). Approximately 25.5% of the patients had comorbidities, with hypertension (17.6%) and diabetes mellitus (11.3%) as the most prevalent conditions. Almost half of the patients had throat irritation/runny nose (49.5%) and cough (59.9%). Approximately 84.9% had completed vaccination. Regarding clinical characteristics, 44.3% of the patients had a body mass index (BMI) of ≥27.5 kg/m^2. About one-quarter had a systolic blood pressure (BP) of ≥140 mmHg (22.2%), diastolic BP of ≥90 mmHg (23.4%) and pulse rate of ≥100 beats per minute (22.7%). Almost all patients had a temperature of <38°C (98.8%), respiratory rate of ≤20 breaths per minute (97.4%) and oxygen saturation of ≥95% (99.1%) (**Table 1**). Regarding clinical staging, 689 (15.64%) patients were classified under stage 1, 3159 (71.69%) under stage 2A, 429 (9.74%) under stage 2B, 62 (1.41%) under stage 3, 66 (1.50%) under stage 4 and 1 (0.02%) under stage 5.

Table 1. Characteristics of the patients at initial assessment in the COVID-19 assessment centres.

	All patients
n, (%)	4406 (100)
Age, year, n (%)	
18–59	3833 (87.0)
≥60	573 (13.0)
Sex, n (%)	
Male	2149 (51.2)
Female	2257 (48.8)
Nationality, n (%)	
Malaysian	4364 (99.0)
Non-Malaysian	42 (1.0)
Comorbidities, n (%)	1123 (25.5)
Diabetes mellitus	500 (11.3)
Hypertension	777 (17.6)
Heart-related illness	93 (2.1)
Lung-related illness	82 (1.9)
Neurological, hepatic, haematological or immunological diseases	24 (0.5)
Pregnancy	111 (2.5)
Presenting symptoms, n (%)	
Throat irritation/runny nose	2180 (49.5)
Cough	2505 (59.9)
Loss of smell	905 (20.5)
Loss of taste	709 (16.1)
Fever	425 (9.6)
Myalgia	397 (9.0)
Diarrhoea	139 (3.2)
Lethargy	138 (3.1)
Difficulty breathing	103 (2.3)
Chest pain	71 (1.6)
Vomiting	63 (1.4)
Worsening symptoms	32 (0.7)
Loss of appetite	23 (0.5)
Reduced frequency of urination/amount of urine	5 (0.1)
Inability to move without assistance	2 (0.05)
Reduced level of consciousness	1 (0.02)
Complaints of chest/stomach pain	1 (0.02)
Vaccination status, n (%)	
Completely vaccinated	3740 (84.9)
Unvaccinated	426 (9.7)
Partially vaccinated	240 (5.4)

Table 1. Continues	
	All patients
Vaccination type, n (%)	1123 (25.5)
BNT162b2	1052 (28.9)
CoronaVac	1763 (48.5)
Others	819 (22.5)
Clinical characteristics	
Body mass index, kg/m^2, n (%)	
<27.5	2324 (55.7)
≥27.5	1849 (44.3)
Temperature, °C, n (%)	
<38	4308 (98.8)
≥38	52 (1.2)
Systolic blood pressure, mmHg, n (%)	
<140	3394 (77.8)
≥140	968 (22.2)
Diastolic blood pressure, mmHg, n (%)	
<90	3340 (76.6)
≥90	1021 (23.4)
Pulse rate, beats per minute, n (%)	
<100	3378 (77.3)
≥100	993 (22.7)
Respiratory rate, breaths per minute, n (%)	
≤20	4105 (97.4)
>20	110 (2.6)
Oxygen saturation, %, n (%)	
≥95	4274 (99.1)
<95	38 (0.9)
Severity of disease, n (%)	
Mild (stages 1 and 2)	4277 (97.1)
Severe (stages 3 to 5)	129 (2.9)

At presentation, more patients aged ≥60 years (27.1%) were diagnosed with severe disease compared to those aged 18–59 years. Comorbidities such as diabetes mellitus (P<0.001), hypertension (P<0.001), heart-related illness (P=0.001) and lung-related illness (P<0.001) were also associated with severe disease. The patients who were unable to move without assistance and had a reduced level of consciousness were diagnosed with severe disease. Other symptoms associated with severity of disease were fever (P<0.001), difficulty breathing (P<0.001), chest pain (P<0.001), loss of appetite (P<0.001), lethargy (P<0.001) and throat irritation/runny nose (P=0.003). There were also associations found between the vaccination type and disease severity (P=0.001). Regarding the clinical characteristics, higher BMI (P=0.003), temperature (P=0.003), pulse rate (P<0.001) and respiratory rate (P<0.001) upon initial assessment in the CACs were associated with severe disease. Most patients with severe disease (29.8%) also had an oxygen saturation of <95% (P<0.001) (**Table 2**).

Table 2. Characteristics of the patients at initial assessment in the COVID-19 assessment centres.

	Mild disease	**Severe disease**	***P*-value**
n, (%)	4277 (97.1)	129 (2.9)	
Age, year, n (%)			**<0.001**
18–59	3739 (87.4)	94 (72.9)	
≥60	538 (12.6)	35 (27.1)	
Sex, n (%)			0.072
Male	2076 (51.5)	73 (43.5)	
Female	2201 (48.5)	56 (56.6)	

Table 2. Continued

	Mild disease	Severe disease	*P*-value
Nationality, n (%)			1.000*
18–59	3739 (87.4)	94 (72.9)	
≥60	538 (12.6)	35 (27.1)	
Comorbidities, n (%)	1061 (24.8)	62 (48.1)	**<0.001**
Diabetes mellitus	469 (11.0)	31 (24.0)	**<0.001**
Hypertension	730 (17.0)	47 (36.4)	**<0.001**
Heart-related illness	84 (2.0)	9 (7.0)	**0.001***
Lung-related illness	71 (1.7)	11 (8.5)	**<0.001***
Neurological, hepatic, haematological or immunological diseases	23 (0.5)	1 (0.8)	0.511*
Pregnancy	111 (2.6)	0 (0)	0.078*
Presenting symptoms, n (%)			
Throat irritation/runny nose	2133 (49.9)	47 (36.4)	**0.003**
Cough	2421 (56.6)	84 (65.1)	0.054
Loss of smell	881 (20.6)	24 (18.6)	0.581
Loss of taste	683 (16.0)	26 (20.2)	0.202
Fever	375 (8.8)	50 (38.8)	**<0.001**
Myalgia	381 (8.9)	16 (12.4)	0.172
Diarrhoea	133 (3.1)	6 (4.7)	0.324
Lethargy	120 (2.8)	18 (14.0)	**<0.001***
Difficulty breathing	58 (1.4)	45 (34.9)	**<0.001***
Chest pain	55 (1.3)	16 (12.4)	**<0.001***
Vomiting	59 (1.4)	4 (3.1)	0.105
Worsening symptoms	30 (0.7)	2 (1.6)	0.241*
Loss of appetite	15 (0.4)	8 (6.2)	**<0.001***
Reduced frequency of urination/amount of urine	5 (0.1)	0 (0)	1.000*
Inability to move without assistance	0 (0)	2 (1.6)	**<0.001***
Reduced level of consciousness	0 (0)	1 (0.8)	**0.029***
Complaints of chest/stomach pain	1 (0)	0 (0)	1.000*
Vaccination status, n (%)			0.375
Completely vaccinated	3634 (85.0)	106 (82.2)	
Unvaccinated	409 (9.6)	17 (13.2)	
Partially vaccinated	234 (5.5)	6 (4.7)	
Vaccination type, n (%)			**0.001**
BNT162b2	1037 (29.4)	15 (14.6)	
CoronaVac	1696 (48.0)	67 (65.0)	
Others	798 (22.6)	21 (20.4)	
Clinical characteristics			
Body mass index, kg/m^2, n (%)			**0.003**
<27.5	2273 (56.1)	51 (42.5)	
≥27.5	1780 (43.9)	69 (57.5)	
Temperature, °C, n (%)			**0.003***
<38	4194 (98.9)	114 (95.0)	
≥38	46 (1.1)	6 (5.0)	
Systolic blood pressure, mmHg, n (%)			0.173
<140	3306 (78.0)	88 (72.7)	
≥140	935 (22.0)	33 (27.3)	
Diastolic blood pressure, mmHg, n (%)			0.469
<90	3244 (76.5)	96 (79.3)	
≥90	996 (23.5)	25 (20.7)	

Table 2. Continued			
	Mild disease	Severe disease	*P*-value
Pulse rate, beats per minute, n (%)			**<0.001**
<100	3305 (77.8)	73 (59.8)	
≥100	944 (22.2)	49 (40.2)	
Respiratory rate, breaths per minute, n (%)	1061 (24.8)	62 (48.1)	**<0.001***
≤20	4042 (98.8)	63 (51.6)	
>20	51 (1.2)	59 (48.8)	
Oxygen saturation, %, n (%)			**<0.001***
≥95	4189 (100)	85 (70.2)	
<95	2 (0)	36 (29.8)	

*Fisher's exact test

In the univariate regression analyses, several factors were associated with severe disease (**Table 2**). After these variables were adjusted for in the multivariable analysis, severe disease was associated with hypertension, fever, difficulty breathing, lethargy, throat irritation/runny nose, vaccination type and clinically assessed tachypnoea based on a respiratory rate of >20 breaths per minute and oxygen saturation of <95% (**Table 3**). The patients vaccinated with CoronaVac had almost a threefold higher risk of developing severe COVID-19 than those vaccinated with BNT162b2. Generally, the model explained between 10.9% (Cox and Snell's R^2) and 47.9% (Nagelkerke's R2) of the variance of severe disease and correctly classified 98.1% of the cases. The area under the receiver-operating characteristic curve was 0.893, indicating that the model could accurately discriminate 89.3% of the cases.

Table 3. Risk factors of the severity of COVID-19.

Variables		Adjusted odds ratio (95% confidence interval)	Wald statistics (df)	*P*-value
Age	18–59 years	1.00		
	≥60 years	1.84 (0.84, 4.03)	2.34 (1)	0.126
Diabetes mellitus	No	1.00		
	Yes	0.89 (0.38, 2.04)	0.08 (1)	0.775
Hypertension	No	1.00		
	Yes	2.27 (1.08, 4.75)	4.68 (1)	**0.030**
Heart-related illness	No	1.00		
	Yes	1.25 (0.37, 4.20)	0.13 (1)	0.718
Lung-related illness	No	1.00		
	Yes	2.70 (0.74, 9.89)	2.26 (1)	0.133
Throat irritation/runny nose	No	1.00		
	Yes	0.47 (0.26, 0.84)	6.39 (1)	**0.012**
Fever	No	1.00		
	Yes	4.03 (2.09, 7.75)	17.41 (1)	**<0.001**
Lethargy	No	1.00		
	Yes	2.37 (0.92, 6.12)	3.19 (1)	0.074
Difficulty breathing	No	1.00		
	Yes	4.38 (1.65, 11.59)	8.83 (1)	**0.003**
Chest pain	No	1.00		
	Yes	2.01 (0.66, 6.12)	1.50 (1)	0.220
Loss of appetite	No	1.00		
	Yes	2.68 (0.31, 23.57)	0.79 (1)	0.374
Type of vaccination	BNT162b2	1.00		
	CoronaVac	2.71 (1.25, 5.88)	6.34 (1)	**0.012**
	Others	2.10 (0.87, 5.05)	2.71 (1)	0.100

Table 3. Continued

Variables		Adjusted odds ratio (95% confidence interval)	Wald statistics (df)	*P*-value
Body mass index	<27.5 kg/m²	1.00		
	≥27.5 kg/m²	1.21 (0.69, 2.11)	0.44 (1)	0.507
Temperature	<38°C	1.00		
	≥38°C	0.72 (0.09, 5.56)	0.10 (1)	0.749
Pulse rate	<100 beats per minute	1.00		
	≥100 beats per minute	1.48 (0.81, 2.70)	1.63 (1)	0.202
Respiratory rate	≤20 breaths per minute	1.00		
	>20 breaths per minute	37.30 (18.00, 77.43)	94.29 (1)	**<0.001**
Oxygen saturation	≥95%	1.00		
	<95%	131.84 (24.63, 705.67)	32.53 (1)	<0.001

The variables included in the final analysis were as follows: age, diabetes mellitus, hypertension, heart-related illness, lung-related illness, throat irritation/runny nose, fever, lethargy, difficulty breathing, chest pain, loss of appetite, vaccination type, BMI, temperature, pulse rate, respiratory rate and oxygen saturation. The Lemeshow goodness-of-fit test revealed the following: chi-square=7.057, P=0.531, showing that the model reasonably fitted well. Further, the model assumptions were met, and there were neither interaction nor multicollinearity problems.

Discussion

To the best of our knowledge, this study is the first to describe patients' characteristics and risk factors of COVID-19 severity in the post-vaccination period in primary care facilities in South East Asia. Worldwide, primary care doctors play an immense role during the COVID-19 pandemic by participating in screening, triaging, managing and preventing COVID-19.[4,8,9] COVID-19 prevention strategies include the mass vaccination programme, which started on 24 February 2021 in Malaysia.[10]

In this study, most patients (97.1%) had mild COVID-19, while only 2.9% had severe COVID-19. In comparison, the local study by Sim et al. found that during the pre-vaccination period, 81.8% of patients were classified under stages 1–2 and 18.2% under stages 3–5.[11] The higher proportion of mild cases in this study is most likely attributed to COVID-19 vaccines' effectiveness. Herein, 84.9% of the patients were fully vaccinated; 5.4%, partially vaccinated and 9.7%, unvaccinated. It is well established that COVID-19 vaccination can reduce COVID-19 severity by preventing symptomatic COVID-19 and reducing hospitalisation, intensive care unit (ICU) admission and death.[10,12]

The older patients in this study constituted 13% of the total study population. This figure is consistent with Malaysia's population census in 2020, in which 10.7% or 3.5 million out of 32.7 million were aged >60 years.10 However, older age (>60 years) was not found to be a significant risk factor of severe COVID-19. This finding differs from other reports worldwide during the pre-[5,6,11,13,14] and post-vaccination periods.[15,16] This difference may be attributed to the high vaccination rate among the elderly patients at the time of the study. The phase 2 vaccination programme, which aimed to vaccinate the elderly population, was the second to commence in April 2021 after the vaccination of healthcare workers in late February 2021.[10] In older people (>60 years), vaccination has been proven to be effective at preventing symptomatic disease, according to a meta-analysis of five trials.[17] The other possible reason is that there was mandatory admission of elderly patients under category 2B during the study period. These patients may be admitted earlier and deteriorate in hospitals later. Since the absolute outcomes of COVID-19 were not considered in this study, the findings could differ with other reports.

Fever and respiratory signs and symptoms such as difficulty breathing, respiratory rate of >20 breaths per minute and oxygen saturation of <95% were found to be significantly associated with severe COVID-19. These findings are similar to other reports.[11,13,14] The findings are expected, as COVID-19 is caused by SARS-CoV-2, which primarily affects the lungs.[13,18] Pulmonary complications are also more common than other organ dysfunctions in patients with COVID-19.[11] Sim et al. reported that baseline abnormal chest radiographic findings indicating COVID-19

pneumonia were associated with poorer disease outcomes.[11] Difficulty breathing or dyspnoea may suggest poor lung function due to inflammatory reactions at the alveolar region, leading to poor oxygenation and, therefore, reduced oxygen concentration.[13] However, several significant factors have wide CIs, which may be attributable to the small number of patients with those characteristics. To verify the results of this study, further studies with a larger sample size must evaluate these factors.

About one-sixth of the patients in this study had hypertension (17.6%) and diabetes mellitus (11.3%). This finding is expected, as hypertension and diabetes mellitus are the two most common chronic diseases in Malaysia.[19] The National Health and Morbidity Survey conducted in 2019 showed that the overall prevalence of diabetes mellitus and hypertension among adults was 18.3% and 30%, respectively.[19] These two chronic conditions are known to be significant risk factors of severe COVID-19.[20,21] During the pre-vaccination period, comorbidities such as diabetes mellitus, hypertension, chronic lung diseases, cardiovascular diseases[6,13,14,18,20,21] and chronic kidney disease[11,22] were associated with poorer outcomes including ICU admission and death. Similarly, Yek et al. showed that among patients who had completed the primary vaccination, those who were older than 65 years, were immunosuppressed or had at least one of the six underlying chronic diseases (diabetes mellitus, chronic kidney disease, chronic neurologic disease, chronic cardiac disease, chronic lung disease and chronic liver disease), were at a greater risk for severe outcomes.[15] The risk factors of severe COVID-19 remain similar regardless of whether the studies were conducted during the pre- or post-vaccination period. The only difference is the substantial reduction of disease burden and severity. The reduction of healthcare burden has enabled a gradual recovery of economic sectors as seen in Malaysia, Singapore and the United Kingdom.[10] However, this study found only hypertension to be significantly associated with severe COVID-19 in the multivariable analysis. Diabetes mellitus was found to be significant only in the univariate analysis. Since this study focused on patients in primary care facilities and had a cross-sectional design, the absolute patient outcomes were not determined. Therefore, previously established risk factors such as diabetes mellitus may become insignificant. Other possible confounding variables within the diabetes mellitus group, such as glycaemic control, duration of diabetes mellitus, medication used or the presence of specific diabetes mellitus-related complications, might not have been accounted for in this study.[23] A study conducted in the district showed that diabetes mellitus control was better than the national findings, which may influence the outcomes.[24] Patients with diabetes mellitus and hypertension have been shown to have lower levels of immunity over time, reducing their resistance to viral infections. Furthermore, long-term diabetes mellitus and hypertension can damage the vascular structure and weaken the heart function, increasing the risk of developing critical COVID-19.[13] Lung- and heart-related illnesses have also been reported in earlier studies as significant risk factors of severe COVID-19.[15,16] The small number of patients with these comorbidities in this study owing to possible under-reporting in the Selangkah system may have caused the difference in these results.

Malaysia's National COVID-19 Vaccination Programme (PICK) commenced on 24 February 2021. BNT162b2 (Pfizer-BioNTech), CoronaVac (Sinovac) and AZD1222 (AstraZeneca) were the three most commonly administered vaccines in Malaysia.[10] These three vaccines had demonstrated established efficacies in clinical studies in real-world settings.[25–27] In this study, 84.9% of the patients were fully vaccinated, with CoronaVac as the most common (48.5%) type of vaccine administered, followed by BNT162b2 (28.9%) and other types (22.5%). We found that the patients who received CoronaVac were at a higher risk (adjusted odds ratio=2.71) of developing severe COVID-19 than those who received BNT162b2. This result is consistent with the data from a large-scale vaccine effectiveness study conducted by the Ministry of Health Malaysia that BNT162b2 and AZD1222 vaccines were better than CoronaVac in preventing ICU admission and COVID-19-related death.[10] Nevertheless, the study concluded that all three vaccines were effective in preventing ICU admission (79.1%) and death (86.7%). Rotshild et al. also demonstrated that BNT162b2 was superior to CoronaVac in preventing symptomatic COVID-19.[17]

Our findings have implications for various stakeholders, including the general public, healthcare policy makers, patients with COVID-19, doctors and paramedics in primary care facilities. The findings could assist primary care healthcare workers in prioritising patients for hospital admission during assessment in primary care clinics or CACs. From this study, it is evident that breakthrough infections following primary vaccination can occur as in other reports and can sometimes be severe. The risk factors of severe COVID-19 during the pre- and post-vaccination periods are somewhat similar.[15,16] Nevertheless, the number of severe COVID-19 cases among vaccinated patients is substantially reduced.[10,28] Future studies may be conducted to determine whether modification of the risk factors, especially comorbidities, would reduce the vulnerability to severe COVID-19.

Strength and limitation

Our study was conducted during the post-vaccination period, and the vaccination rate was high (84.9%). COVID-19 studies in the post-vaccination period are still relatively scarce, especially in Asia. There are several limitations to our study. First, we studied only the patients' severity during the first visit. Therefore, the absolute patient outcomes were not determined. Patients' condition may improve or deteriorate after the first clinical assessment over the course of illness. Other important outcome measures such as hospitalisation or disease deterioration were not evaluated, which may underrepresent severe COVID-19 cases and limit the translation of the findings to clinical practice. Second, owing to the retrospective study design, the numbers of patients with cardiovascular, respiratory, neurological, haematological and immunological diseases were small. These conditions are not as common as diabetes mellitus and hypertension. The risk factors of severe COVID-19 identified in our study are inconsistent with other reports during the post-vaccination era.[15,16] Some risk factors established also have wide CIs owing to the small number of patients with those characteristics. More extensive studies involving a greater number of patients are necessary to validate the present results. Furthermore, our study was able to evaluate only the impact of the primary series of COVID-19 immunisation on the study population. As the booster vaccination programme is on-going, future studies may be conducted to address the impact of booster doses on COVID-19 severity. Lastly, the cross-sectional design of the study limits the consideration of causality.

Conclusion

The majority of the COVID-19 cases seen in primary care facilities during the post-COVID-19 vaccination period in Malaysia were mild. Identification of the factors associated with severe disease and judicious hospital referral will not overwhelm the already constrained public healthcare resources.

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Author contributions

LYS and HBK conceptualised the study. LYS and JJ collected and analysed the data and wrote the manuscript with advice from HBK. All authors critically revised the manuscript.

Ethical approval

This study received ethical approval from the Medical Research Ethics Committee of the Ministry of Health Malaysia (NMRR ID-22-01601-DS8).

Conflicts of interest

None.

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None.

Data sharing statement

Raw data are available only upon request with permission from Selangkah.

How does this paper make a difference in general practice?

- Understanding the factors associated with COVID-19 severity allows primary care practitioners to prioritise high-risk patients presenting to primary care clinics and allocate appropriate resources for their care.
- Patients with hypertension or primary vaccination with CoronaVac may be recognised sooner as being at risk of severe COVID-19 .
- The established risk factors including comorbidities can inform public health campaigns to raise awareness and encourage preventive measures in primary care.
- The present data can be used for comparative analysis with future research, enabling a better understanding of the evolving nature COVID-19 and its impact on primary care and public health.

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