CLINICAL CHARACTERISTICS, TREATMENT OUTCOMES AND DISEASE SEVERITY RELATED FACTORS AMONG PEDIATRIC COVID-19 PATIENTS IN RURAL THAILAND

Nootwadee Wankaew Asanathong[1], Supisara Suttiwaree[2], Kris Wansri[2], Sirikanya Prommali[2], Prarinphong Saenjai[2] and Nidhikul Tem-eiam[1]

[1]Sisaket Hospital, Si Sa Ket Province, Thailand; [2]Faculty of Medicine, Ubon Ratchathani University, Ubon Ratchathani Province, Thailand

Abstract. Coronavirus Disease-2019 (COVID-19) caused by Severe Acute Respiratory Syndrome-Cororonavirus-2 (SARS-CoV-2) is a cause of morbidity among pediatric patients in rural Thailand. In this study we aimed to review cases of COVID-19 among pediatric patients in rural Thailand in order to determine the clinical characteristics, treatment outcomes and severity related-factors in this cohort to better understand the epidemiology of COVID-19 in this patient population. We retrospectively reviewed the medical records of pediatric (aged <15 years) COVID-19 patients confirmed to have COVID-19 by RT-PCR, treated at 22 regular and 33 field hospitals in Si Sa Ket Province, Thailand during April-August 2021. A total of 863 subjects were included in the study, 52.1% male. Three hundred seventy-seven (43.7%) were asymptomatic, 416 (48.2%) had a mild infection, defined as those without pneumonia, 66 (7.7%) had a moderate infection, defined as those with pneumonia but not requiring oxygen or critical care and 4 (0.5%) had a severe infection, defined as those needing oxygen and/or critical care. The median age of subjects with moderate/severe COVID-19 (4 years) was significantly (p=0.017) lower than subjects who had mild/asymptomatic COVID-19 (7 years). The median weight for height of subjects with moderate/severe COVID-19 (107%) was significantly (p=0.008) greater than subjects who had mild/symptomatic COVID-19 (103%). The percentage of subjects who had medical diseases with moderate/severe COVID-19 (7.1%) was not significantly different (p=0.075) from those who had mild/asymptomatic COVID-19 (4.0%). The most common underlying diseases among study subjects with COVID-19 were allergies and asthma. The percentage of subjects with mild/asymptomatic COVID-19 who had underlying allergies or asthma (4.3%) was not significantly different (p=0.174) than the percentage with moderate/severe COVID-19 (1.9%). The most common symptoms among those with mild/asymptomatic illness

and moderate/severe illness were fever (33.3% and 38.6%, respectively; p=0.412) and cough (26.2 % and 35.7%, respectively; p=0.124). Sixty-seven subjects (7.8%) had pneumonia on radiography but 32.8% of these were asymptomatic. All 863 subjects had improved by discharge. On multivariable logistic regression analysis, subjects with rhinorrhea were significantly less likely to have moderate/severe COVID-19 than those without rhinorrhea (adjusted OR: 0.36; 95%CI: 0.15-0.88; p=0.024). In summary, only 0.5% of our subjects had severe COVID-19 and 8.2% developed pneumonia. Younger and higher weight for height subjects were more likely to have severe infection. Those with rhinorrhea were more likely to have mild infection. In conclusion, younger subjects and higher weight for height subjects need to be monitored more carefully than those with rhinorrhea. Further studies are needed to determine if these factors can be used to predict the course and outcome of other subjects.

Keywords: COVID-19, clinical characteristics, severity factor, pediatric, Thailand

Correspondence: Nootwadee Wankaew Asanathong, Division of Pediatric, Sisaket Hospital, 586 Kasikum Road, Mueang Si Sa Ket District, Si Sa Ket Province 33000, Thailand
Tel: +66 (08) 9846-1525 E-mail: nootwadee@gmail.com

INTRODUCTION

Coronavirus Disease-2019 (COVID-19) caused by Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2) has infected >490 million people worldwide (WHO, 2022). Although a vaccine to prevent severe COVID-19 in children has been introduced for use, the number of COVID-19 cases among Thai children has continued to increase, partly due to inadequate vaccination coverage (WHO, 2022). COVID-19 in children is usually mild with a good outcome (ECDC, 2021) but since April 2021 the number of children in Thailand with more severe COVID-19 has increased (Anugulruengkitt *et al*, 2021) spurred on by at that time a wave of delta variant infections (WHO Thailand, 2021). At that time the Thai National Treatment Guidelines for COVID-19 recommended favipiravir as the treatment of choice for symptomatic, pneumonic patients and those at risk for developing severe disease. At that time there was limited access to remdesivir, which was reserved for selected severe cases (MOPH Thailand,

2021). Most of the affected patients were adults there was little data about COVID-19 infection among children in Thailand.

The exact numbers and severity of COVID-19 among rural Thai children have not been studied. Therefore, in this study we aimed to review cases of COVID-19 among pediatric patients in rural Thailand in order to determine the clinical characteristics, treatment outcomes and severity related-factors in this cohort to better understand the epidemiology of this patient population.

MATERIALS AND METHODS

We retrospectively reviewed the records of all children aged <15 years diagnosed with COVID-19 in Si Sa Ket Province, northeastern Thailand during 1 April 2021 - 31 August 2021. The records were obtained from 22 regular and 33 field hospitals treating COVID-19 in Si Sa Ket Province. All study subjects were confirmed to have COVID-19 infection by reverse transcriptase-polymerase chain reaction (RT-PCR) for SARS-CoV-2 and all the subjects were admitted to one of the study hospitals. A chest x-ray was done on each study subject on admission. Cycle threshold (Ct) RT-PCR values for the N, ORF1ab, RdRP, E, S, and RnaseP genes reported with the RT-PCR results where available.

The charts of all pediatric patients with COVID-19 were reviewed and the following data were collected: demographic data, weight, height, clinical symptoms, history of underlying medical conditions, chest x-ray results and discharge status.

Study subjects were classified into 4 severity groups: 1) asymptomatic with a normal chest x-ray, 2) mild-defined as having mild upper respiratory, gastrointestinal or other symptoms without pneumonia on chest x-ray, 3) moderate-defined as having pneumonia on chest x-ray but not needing intensive care or oxygen treatment and 4) severe-needing intensive care and oxygen therapy (having a room air oxygen saturation <95% or signs of difficult breathing).

All data analyses were performed using Stata, version 15.1 (Stata Corp, College Station, TX). Demographic data and clinical characteristics were described using frequencies and percentages for categorical data and means ± standard deviations (SD) or medians ± interquartile ranges (IQR) for continuous data. We used the Chi-square test or Fisher's exact test to compare categorical variables and the Wilcoxon rank-sum test to compare continuous variables. We analyzed severity-related clinical factors using multivariable logistic regression analyses with odds ratios (OR) and 95% confidence intervals (CI). We used univariate analyses of selected factors with a p-value <0.2 to determine which factors to include in

multivariable logistic regression using a *p*-value <0.05 to determine statistical significance.

This study was approved ethically by the Institutional Review Board of Sisaket Hospital (approval no. 101/2564).

RESULTS

Patient demographics and underlying medical conditions

A total of 863 subjects were included in the study, 52.1% male. The median (interquartile range (IQR)) ages of study subjects were 7 (3-11) years (range: 1 day-15 years) (Table 1). Of the 863 subjects, 43.7% (*n* = 377) were classified as asymptomatic, 48.2% (*n* = 416) as mild, 7.7% (*n* = 66) as moderate (44 with symptomatic and 22 with asymptomatic pneumonia) and 0.5% (*n* = 4) as severe. The 4 severe cases consisted of: a 1-year-old male with acute gastroenteritis and hypovolemic shock, an 11-year-old male with acute asthma exacerbation, a 2-month-old female with pneumonia preceded by bronchitis and a 1-year-old male with croup having a Westley croup score of 7.

The asymptomatic and mild cases were grouped and the moderate and severe cases were grouped in order to determine the factors related pneumonia or having severe COVID-19. The median age of the moderate/severe subjects (4 years) was significantly lower (*p*=0.017) than asymptomatic/mild cases (7 years). The median weight for height in the moderate/severe cases (107%) was significantly greater (*p*=0.008) than asymptomatic/mild cases (103%).

Thirty-seven subjects (4.2%) had an underlying medical disease consisting of allergies or asthma (*n* = 18; 2.1%), thalassemia (*n* = 5; 0.6%), G6PD deficiency (*n* = 4; 0.5%), epilepsy (*n* = 4; 0.5%), developmental delay (*n* = 2; 0.2%), autism (*n* = 1; 0.1%), heart disease (*n* = 1; 0.1%), renal disease (*n* = 1; 0.1%) and being born preterm (*n* = 1; 0.1%). Of the 37 subjects with an underlying medical condition, 32 had asymptomatic/mild COVID-19 and 5 had moderate/severe COVID-19. There was no significant difference in the proportion of subjects with underlying disease between those with asymptomatic/mild and moderate/severe COVID-19 (7.1% *vs* 4.0%; *p*=0.075). There was also no significant difference between the proportions of subjects with and without the most common underlying condition of allergies/asthma (asymptomatic/mild 4.3% *vs* moderate/sever 1.9%; *p*=0.174).

Cycle threshold RT-PCR values

Of the total of 863 subjects, 754 had Ct RT-PCR values for the N, ORF1ab, RdRP, E, S, and RnaseP genes. There were no significant differences in the Ct values for any of the tested genes between those with asymptomatic/mild and moderate/severe COVID-19 (Table 2).

Table 1

Study subject demographic data by disease severity

Characteristics	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic (N = 377)	Mild (N = 416)	Moderate (N = 66)	Severe (N = 4)	Asymptomatic and mild (N = 793)	Moderate and severe (N = 70)	*p*-value
Sex, *n* (%)							
Male	202 (53.6)	207 (49.8)	38 (57.6)	3 (75.0)	409 (51.6)	41 (58.6)	0.261
Female	175 (46.4)	209 (50.2)	28 (42.4)	1 (25.0)	384 (48.4)	29 (41.4)	
Age in years, median (IQR)	6 (3,10)	7 (3,11.5)	4 (2,10)	1 (0.58,6)	7 (3,11)	4 (1,10)	0.017
Age group, *n* (%)							
<1 year	27 (7.2)	32 (7.7)	9 (13.6)	1 (25.0)	59 (7.4)	10 (14.3)	
1 - <5 years	115 (30.5)	119 (28.6)	25 (37.9)	2 (50.0)	234 (29.5)	27 (38.6)	
5-15 years	235 (62.3)	265 (63.7)	32 (48.5)	1 (25.0)	500 (63.1)	33 (47.1)	
Weight in kg, median (IQR)	23 (15,35)	25 (15,42)	19 (12,35.5)	9.5 (6,20.5)	24 (15,40)	18.5 (11.3,34.5)	0.508
Weight for age percentile group, *n* (%)							
<P3	14 (4.0)	16 (4.0)	1 (1.6)	0 (0.0)	30 (4.0)	1 (1.5)	
P3-P97	284 (81.1)	312 (78.4)	50 (78.1)	4 (100.0)	596 (79.7)	54 (79.4)	
>P97	52 (14.9)	70 (17.6)	13 (20.3)	0 (0)	122 (16.3)	13 (19.1)	
%Weight for height, median (IQR)	102.3 (92.5,119.1)	103.1 (93.3,123)	107.4 (94.7,122.9)	87.0 (72.7,129.4)	102.6 (92.9,122.0)	106.7 (90.9,122.9)	0.008

Table 1 (cont)

Characteristics	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic (N = 377)	Mild (N = 416)	Moderate (N = 66)	Severe (N = 4)	Asymptomatic and mild (N = 793)	Moderate and severe (N = 70)	*p*-value
%Weight for height group, *n* (%)							
>60 - 75%	20 (6.0)	15 (4.1)	4 (7.4)	1 (33.3)	35 (5.0)	5 (8.8)	
>75 - 90%	46 (13.9)	50 (13.5)	6 (11.1)	1 (33.3)	96 (13.7)	7 (12.3)	
>90 - 120%	185 (55.9)	201 (54.3)	28 (51.8)	0 (0.0)	386 (55.1)	28 (49.1)	
>120 - 140%	54 (16.3)	62 (16.8)	6 (11.1)	1 (33.3)	116 (16.5)	7 (12.3)	
>140 - 200%	25 (7.6)	39 (10.5)	7 (13.0)	0 (0.0)	64 (9.1)	7 (12.3)	
>200%	1 (0.3)	3 (0.8)	3 (5.6)	0 (0.0)	4 (0.6)	3 (5.2)	
Underlying disease, *n* (%)							0.075
Autism	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1.000
Delay development	0 (0.0)	0 (0.0)	2 (3.0)	0 (0.0)	0 (0.0)	2 (2.8)	0.006
Allergy or asthma	4 (1.0)	11 (2.6)	2 (3.0)	1 (25.0)	15 (1.9)	3 (4.3)	0.174
Heart disease	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1.000
Epilepsy	2 (0.5)	2 (0.5)	0 (0.0)	0 (0.0)	4 (0.5)	0 (0.0)	1.000
Renal disease	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1.000
Thalassemia	1 (0.3)	4 (1.0)	0 (0.0)	0 (0.0)	5 (0.7)	0 (0.0)	1.000
G6PD deficiency	0 (0.0)	4 (1.0)	0 (0.0)	0 (0.0)	4 (0.5)	0 (0.0)	1.000
Preterm	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1.000
None	368 (97.6)	393 (94.5)	62 (94.0)	3 (75.0)	761 (96.0)	65 (92.9)	0.219

COVID-19: coronavirus disease-2019; G6PD: glucose-6-phosphate dehydrogenase; IQR: interquartile range; kg: kilogram

Table 2

SARS-CoV-2 RT-PCR cycle threshold values among study subjects

Cycle threshold (Ct) value	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic	Mild	Moderate	Severe	Asymptomatic and mild	Moderate and severe	*p*-value
Orf-1ab gene							
Total number	282	309	48	1	591	49	
median (IQR)	26.2 (21.6,32.1)	22.4 (18.7,27.3)	23.7 (20.4,29.8)	22.9 (22.9,22.9)	24.4 (20.1,30.1)	23.5 (20.6,29.5)	0.970
gene group, *n* (%)							
<20	43 (15.3)	99 (32.1)	8 (16.7)	0 (0)	142 (24.0)	8 (16.3)	
20 - <30	140 (49.6)	158 (51.1)	28 (58.3)	1 (100.0)	298 (50.4)	29 (59.2)	
30 - <40	99 (35.1)	52 (16.8)	12 (25.0)	0 (0)	151 (25.6)	12 (24.5)	
N gene							
Total number	324	362	55	4	686	59	
median (IQR)	23.8 (19.8,29.9)	21.1 (17.2,26.1)	23.3 (19.3,29.4)	20.5 (16.7,22.6)	22.7 (18.1,27.7)	23.2 (19.1,29.2)	0.291
gene group, *n* (%)							
<20	83 (25.6)	157 (43.4)	17 (30.9)	2 (50.0)	240 (35.0)	19 (32.2)	
20 - <30	163 (50.3)	160 (44.2)	29 (52.7)	2 (50.0)	323 (47.1)	31 (52.5)	
30 - <40	78 (24.1)	45 (12.4)	9 (16.4)	0 (0)	123 (17.9)	9 (15.3)	

Table 2 (cont)

Cycle threshold (Ct) value	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic	Mild	Moderate	Severe	Asymptomatic and mild	Moderate and severe	*p*-value
RdRP gene							
Total number	40	51	8	3	91	11	
mean ± SD	26.1 ± 5.2	25.0 ± 5.5	31.5 ± 5.7	19.4 ± 3.8	25.5 ± 5.4	28.2 ± 7.6	0.136
gene group, *n* (%)							
<20	5 (12.5)	10 (19.6)	1 (12.5)	2 (66.7)	15 (16.5)	3 (27.3)	
20 - <30	26 (65.0)	31 (60.8)	1 (12.5)	1 (33.3)	57 (62.6)	2 (18.2)	
30 - <40	9 (22.5)	10 (19.6)	6 (75.0)	0 (0)	19 (20.9)	6 (54.5)	
Rnase P gene							
Total number	5	2	2	0	7	2	
mean ± SD	25.6 ± 2.2	26.7 ± 1.0	27.3 ± 0.2	-	25.9 ± 1.9	27.3 ± 0.2	0.242
gene group, *n* (%)							
<20	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
20 - <30	5 (100.0)	2 (100.0)	2 (100.0)	0 (0)	7 (100.0)	2 (100.0)	
30 - <40	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

Table 2 (cont)

Cycle threshold (Ct) value	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic	Mild	Moderate	Severe	Asymptomatic and mild	Moderate and severe	*p*-value
E gene							
Total number	11	14	2	1	25	3	
mean ± SD	22.0 ± 7.1	20.3 ± 4.8	21.5 ± 3.9	11.8 ± 0.0	21.1 ± 5.9	18.3 ± 6.3	0.442
gene group, *n* (%)							
<20	4 (36.4)	5 (35.7)	1 (50.0)	1 (100.0)	9 (36.0)	2 (66.7)	
20 - <30	5 (45.4)	9 (64.3)	1 (50.0)	0 (0)	14 (56.0)	1 (33.3)	
30 - <40	2 (18.2)	0 (0)	0 (0)	0 (0)	2 (8.0)	0 (0)	
S gene							
Total number	4	4	1	0	8	1	
mean ± SD	24.1 ± 5.0	22.2 ± 2.4	26.4 ± 0.0	-	23.2 ± 3.8	26.4	0.245
gene group, *n* (%)							
<20	0 (0)	1 (25.0)	0 (0.0)	0 (0.0)	1 (12.5)	0 (0.0)	
20 - <30	3 (75.0)	3 (75.0)	1 (100.0)	0 (0.0)	6 (75.0)	1 (100.0)	
30 - <40	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (12.5)	0 (0.0)	

COVID-19: coronavirus disease-2019; Ct: cycle threshold value; E: envelope; IQR: interquartile range; N: nucleocapsid; Orf-1 ab: open reading frame-1 ab; RdRP: RNA-dependent RNA polymerase; Rnase P: ribonuclease P; RT-PCR: reverse transcriptase polymerase chain reaction; S: spike; SARS-CoV-2: severe acute respiratory syndrome-coronavirus-2; SD: standard deviation

Presenting symptoms and hospital outcomes

Among subjects with asymptomatic/mild COVID-19, cough (*n* = 264; 33.3%) and fever (*n* = 208; 26.2%) were the most common presenting symptoms. Among subjects with moderate/severe COVID-19, fever (*n* = 27; 38.6%) and cough (*n* = 25; 35.7%) were the most common presenting symptoms. The proportions of subjects with asymptomatic/mild COVID-19 and moderate/severe COVID-19 with fever (p=0.412) and cough (p=0.124) were not significantly different from each other. All patients were discharged in an improved condition (Table 3).

Factors associated with moderate/severe COVID-19

On univariable logistic regression analysis: 1) for each additional year in subject age there was a 6% lower likelihood of having moderate/severe COVID-19 (Odds Ratio (OR): 0.94; 95% confidence interval (CI): 0.89-0.99; p=0.032); 2) subjects with rhinorrhea had a significantly lower likelihood of having moderate/severe COVID-19 (OR: 0.45; 95%CI: 0.22-0.93; p=0.032).

On multivariable logistic regression analysis, subjects with rhinorrhea had a significantly lower likelihood of having moderate/severe COVID-19 than those without rhinorrhea (adjusted OR: 0.36; 95%CI: 0.15-0.88; p=0.024) (Table 4).

DISCUSSION

In our study, subjects were aged 1 day old to 15 years with the most common age being 7 years, similar to studies from China (7 years) and Bangkok, Thailand (7 years) (Dong *et al*, 2020; Anugulruengkitt *et al*, 2021) but different from studies from the USA (12-12.5 years) (Kompaniyets *et al*, 2021a; Martin *et al*, 2021), Hong Kong (12.9 years), Korea (10.8 years), and China (6.6 years) (Chua *et al*, 2020).

In our study, we found no significant difference in the sex ratio among subjects, similar to other studies (Chua *et al*, 2020; Dong *et al*, 2020; Anugulruengkitt *et al*, 2021; Kompaniyets *et al*, 2021a; Martin *et al*, 2021).

In our study, nearly all the subjects had asymptomatic/mild COVID-19, similar to studies from China (Dong *et al*, 2020), the USA (Kompaniyets *et al*, 2021a; Martin *et al*, 2021) and Southeast Asia (Wong *et al*, 2021). In our study, 8% of subjects developed pneumonia, fewer than studies from mainland China (39%) (Dong *et al*, 2020), West China (82%) (Zhang *et al*, 2020) and Bangkok, Thailand (23%) (Anugulruengkitt *et al*, 2021). The latter study from Bangkok was at the largest referral center in Thailand so they would be expected to have more severe cases than other hospitals in Thailand. The study from Bangkok used chest x-rays to detect COVID-19

Table 3

Clinical characteristics and treatment outcomes by disease severity among study subjects

Characteristics	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic (N = 377)	Mild (N = 416)	Moderate (N = 66)	Severe (N = 4)	Asymptomatic and mild (N = 793)	Moderate and severe (N = 70)	*p*-value
Clinical symptoms, *n* (%)							
Fever	0 (0.0)	208 (50.0)	25 (37.9)	2 (50.0)	208 (26.2)	27 (38.6)	0.412
Cough	0 (0.0)	264 (63.5)	23 (34.8)	2 (50.0)	264 (33.3)	25 (35.7)	0.124
Rhinorrhea	0 (0.0)	153 (36.8)	9 (13.6)	1 (25.0)	153 (19.3)	10 (14.3)	0.028
Nasal congestion	0 (0.0)	18 (4.3)	3 (4.5)	0 (0.0)	18 (2.3)	3 (4.3)	0.468
Sore throat	0 (0.0)	42 (10.1)	7 (10.6)	1 (25.0)	42 (5.3)	8 (11.4)	0.165
Hoarseness	0 (0.0)	1 (0.2)	0 (0)	1 (25.0)	1 (0.1)	1 (1.4)	0.196
Dyspnea	0 (0.0)	0 (0.0)	1 (1.5)	2 (50.0)	0 (0.0)	3 (4.3)	0.001
Headache	0 (0.0)	9 (2.2)	2 (3.0)	0 (0.0)	9 (1.1)	2 (2.9)	0.317
Myalgia	0 (0.0)	2 (0.5)	0 (0.0)	0 (0.0)	2 (0.3)	0 (0.0)	1.000
Anosmia	0 (0.0)	19 (4.6)	2 (3.0)	0 (0.0)	19 (2.4)	2 (2.9)	1.000
Ageusia	0 (0.0)	5 (1.2)	0 (0.0)	0 (0.0)	5 (0.6)	0 (0.0)	1.000
Diarrhea	0 (0.0)	13 (3.1)	0 (0.0)	1 (25.0)	13 (1.6)	1 (1.4)	1.000
Nausea or vomiting	0 (0.0)	6 (1.4)	0 (0.0)	0 (0.0)	6 (0.8)	0 (0.0)	1.000
Rash	0 (0.0)	15 (3.6)	0 (0.0)	0 (0.0)	15 (1.9)	0 (0.0)	0.384
Red eye	0 (0.0)	3 (0.7)	1 (1.5)	0 (0.0)	3 (0.4)	1 (1.4)	0.355
Seizure	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.1)	1 (1.4)	1.000

Table 3 (cont)

Characteristics	COVID-19 disease severity				COVID-19 disease severity groups		
	Asymptomatic (N = 377)	Mild (N = 416)	Moderate (N = 66)	Severe (N = 4)	Asymptomatic and mild (N = 793)	Moderate and severe (N = 70)	*p*-value
Diagnosis, *n* (%)							
URI or bronchitis	0 (0.0)	343 (82.5)	35 (53.0)	1 (25.0)	343 (43.3)	36 (51.4)	<0.001
Croup	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	1 (1.4)	0.144
Symptomatic pneumonia	0 (0.0)	0 (0.0)	44 (66.7)	1 (25.0)	0 (0.0)	45 (64.3)	<0.001
Asymptomatic pneumonia	0 (0.0)	0 (0.0)	22 (33.3)	0 (0.0)	0 (0.0)	22 (31.4)	<0.001
Acute febrile illness	0 (0.0)	63 (15.1)	0 (0.0)	0 (0.0)	63 (7.9)	0 (0.0)	<0.001
Asthma exacerbation	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	1 (1.4)	0.144
Gastroenteritis	0 (0.0)	18 (4.3)	0 (0.0)	1 (25.0)	18 (2.3)	1 (1.4)	0.335
Viral exanthematous	0 (0.0)	13 (3.1)	0 (0.0)	0 (0.0)	13 (1.6)	0 (0.0)	0.231
Viral conjunctivitis	0 (0.0)	3 (0.7)	1 (1.5)	0 (0.0)	3 (0.4)	1 (1.4)	0.464
Hypovolemic shock	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	1 (1.4)	0.144
Febrile convulsion	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1.000
Chest film, *n* (%)							
Normal	377 (100.0)	416 (100.0)	0 (0)	3 (75.0)	793 (100.0)	3 (4.3)	<0.001
Abnormal	0 (0.0)	0 (0.0)	66 (100.0)	1 (25.0)	0 (0.0)	67 (95.7)	
Outcome, *n* (%)							
Improve	377 (100.0)	416 (100.0)	66 (100.0)	4 (100.0)	793 (100.0)	70 (100.0)	
Death	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	

COVID-19: coronavirus disease 2019; URI: upper respiratory tract infection

Table 4

Evaluation of association between selected study subject characteristics and moderate to severe COVID-19 using univariable and multivariable logistic regression analysis

Characteristics	Univariable analysis		Multivariable analysis	
	cOR (95%CI)	*p*-value	aOR (95%CI)	*p*-value
Age	0.94 (0.89-0.99)	0.032	0.93 (0.86-1.01)	0.069
Sex				
Male	1.33 (0.81-2.17)	0.263	1.07 (0.53-2.17)	0.855
Female	1.00		1.00	
% weight for height				
<90%	1.00		1.00	
90-120%	0.79 (0.39-1.60)	0.516	0.64 (0.27-1.52)	0.310
>120%	1.01 (0.47-2.18)	0.983	0.84 (0.32-2.22)	0.722
Underlying disease				
None	1.00		1.00	
Underlying diseases	1.83 (0.69-4.85)	0.225	1.30 (0.28-6.02)	0.737

Table 4 (cont)

Characteristics	Univariable analysis		Multivariable analysis	
	cOR (95%CI)	*p*-value	aOR (95%CI)	*p*-value
Clinical symptoms				
Fever	1.29 (0.70-2.35)	0.413		
Cough	0.63 (0.34-1.14)	0.126	0.81 (0.41-1.62)	0.559
Rhinorrhea	0.45 (0.22-0.93)	0.032	0.36 (0.15-0.88)	0.024
Nasal congest	1.47 (0.42-5.19)	0.546		
Sore throat	1.78 (0.78-4.05)	0.169	2.34 (0.95-5.78)	0.065
Hoarseness	8.83 (0.54-143.49)	0.126	8.83 (0.51-153.66)	0.135
Headache	1.96 (0.41-9.37)	0.396		
Anosmia	0.91 (0.21-4.03)	0.899		
Diarrhea	0.66 (0.08-5.15)	0.692		
Red eye	2.93 (0.30-28.73)	0.356		

aOR: adjusted odds ratio; CI: confidence interval; cOR: crude odds ratio; COVID-19: coronavirus disease 2019

pneumonia, as did our study, but the study from China mentioned above used chest computed tomographic (CT) scans, which could result in detecting a larger number of cases of pneumonia giving a higher rate of pneumonia. Using chest x-rays to detect COVID-19 pneumonia, we found cases of asymptomatic pneumonia, similar to a study from China using chest CT scans (Liu *et al*, 2020).

In our study 0.5% of subjects had severe COVID-19, similar to a study from the USA (0.74%) (Martin *et al*, 2021) but different from a study from China (6%) (Dong *et al*, 2020), although the study from China included confirmed and suspected cases of COVID-19. During our study in Thailand, all cases of COVID-19 were admitted to the hospital, unlike most other countries. Of these, 0.5% had severe infection, compared to: 0.8% in Singapore, 5.3% in Malaysia, 4.8% in Japan, 3.3% in China, 16% in India, 37.5% in Indonesia and 78% in Pakistan (Wong *et al*, 2021) higher than our result. The study criteria may be different in the studies India, Indonesia and Pakistan mentioned above and this may be the reason the rates are so high from those countries.

In our study, the mean age of subjects with moderate/severe COVID-19 (4 years) was significantly (p=0.017) younger than the mean age of subjects with asymptomatic/mild COVID-19 (7 years), similar to another study from Thailand (4.9 years *vs* 7.4 years, p=0.014) (Anugulruengkitt *et al*, 2021). On univariable analysis, the factor significantly positively associated with moderate to severe COVID-19 was being of a younger age, especially being aged <1 year. Our finding is similar to the findings of other studies (Dong *et al*, 2020; Harwood *et al*, 2022).

In our study, subjects with moderate/severe COVID-19 had a significantly greater weight for height than subjects with asymptomatic/mild COVID-19, similar to the findings of previous studies (Castagnoli *et al*, 2020; Graff *et al*, 2021; Kompaniyets *et al*, 2021b; Cheng *et al*, 2022; Harwood *et al*, 2022; Martin *et al*, 2022; Woodruff *et al*, 2022).

In our study, underlying conditions were not significantly associated with moderate/severe COVID-19 similar to a previous study from the USA (Kompaniyets *et al*, 2021a) but unlike the findings of another study from the USA where the following conditions were significantly associated with moderate/severe COVID-19 in children: having an immunocompromised condition (adjusted odds ratio (aOR): 3.5; p=0.004), having a gastrointestinal condition (aOR: 2.7; p=0.009), having diabetes (aOR: 6.6; p=0.04) or having asthma (aOR: 2.2; p=0.04)(Graff *et al*, 2021).

In our study, we found no significant association between

Ct values and severity of COVID-19 unlike the results of two previous studies from the USA that found lower Ct values among symptomatic subjects than asymptomatic subjects (Chung *et al*, 2021; Strutner *et al*, 2021).

In our study, the most common symptoms of COVID-19 infection were fever, cough and upper respiratory infection symptoms, similar to previous studies from Southeast Asia, South Asia, Japan, China, Hong Kong, Korea, Taiwan and the USA (Zhang *et al*, 2020; Chua *et al*, 2020; Graff *et al*, 2021; Jang *et al*, 2021; Wong *et al*, 2021; Lien *et al*, 2022). We found no difference in the proportions of subjects with fever and cough between those with asymptomatic/mild infection and those with moderate/severe infection, unlike the results of 2 studies from Korea and Asia in general that reported a greater proportion of subjects who fit our criteria for moderate/severe had fever and cough (Jang *et al*, 2021; Wong *et al*, 2021).

In our study, univariable and multivariable analyses showed subjects with rhinorrhea were significantly less likely to have moderate/severe COVID-19 than subjects without rhinorrhea, similar to two previous studies from Korea (Jang *et al*, 2021; Her *et al*, 2021).

A strength of our study was the large number of subjects but a weakness was that it was retrospective, causing us to rely on medical records, which did not all record the same type of data or preform the same type of tests.

In summary, only 0.5% of our subjects had severe COVID-19 and 8.2% developed pneumonia. Younger and higher weight for height subjects were more likely to have severe infection. Those with rhinorrhea were more likely to have mild infection. In conclusion, younger subjects and higher weight for height subjects need to be monitored more carefully than those with rhinorrhea. Further studies are needed to determine if these factors can be used to predict the course and outcome of other subjects.

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CONFLICTS OF INTEREST DISCLOSURE

The authors declare no conflicts of interest.

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