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Incidence and Risk Factors of Long COVID in Children and Adolescents: A Single-Center Cohort Study in Thailand

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ABSTRACT

OBJECTIVE: The study aimed to find the incidence of Long COVID in children less than 18 years of age and associated risk factors.

METHODS: This is an observational retrospective and prospective cohort study of children under 18 years of age with evidence of COVID-19 infection from October 2021 to February 2023. Participants were assessed 3, 6, and 9 months after acute infection, with direct evaluation by pediatricians at the first and third visits and by phone call at 6 months. Long COVID was defined as persistent symptoms for at least three months after initial infection. Factors associated with Long COVID were analyzed using univariate and multivariate logistic regression presented using odds ratio (OR) and a 95% confidence interval (CI).

RESULTS: A total of 233 children (mean age 9.95 years; 50.20% female) were included. At 3 months, 83 (35.62%) had persistent symptoms, decreasing to 24 (10.30%) at 6 months; none reported ongoing symptoms at 9 months. Common complaints at 3 months included dyspnea (34.94%), hair loss (33.73%) and sleep disturbances (25.30%). At 6 months, hair loss (37.50%) and sleep problems (25%) remained prominent. Univariate analysis showed that older age (> 10 years), comorbidity, and moderate severity symptom during acute infection were significantly or borderline significantly associated with Long COVID. In the final multivariate model, only the moderate severity symptom remained independently predictive of persistent symptoms at 6 months (adjusted OR 10.56, 95% CI: 1.01–110.33, p = 0.049).

CONCLUSION: More than a third of the children experienced symptoms at 3 months, while persistent cases decreased substantially at 6 months. A moderate-severity symptom during acute illness was a key independent risk factor for Long COVID. These findings underscore the importance of close monitoring, particularly in patients with moderate-severity symptoms, to ensure timely interventions and support for recovery.

KEYWORDS: long COVID, pediatrics, risk factors, Thailand

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has profoundly affected global health systems and daily life. As of early 2025, over 700 million people around the world had been confirmed to have COVID-19[1]. In Thailand, the cumulative number of cases has exceeded four million[2], with the first case reported in January 2020. Although children

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generally experience milder acute symptoms of COVID-19 compared to adults, they can still develop serious complications, including the multisystem inflammatory syndrome in children[3].

Beyond acute illness, the focus has turned toward 'Long COVID', a condition characterized by persistent health problems following SARS-CoV-2 infection[4-6]. These problems can persist for months and encompass a wide range of physical and psychological symptoms[7]. Although standard clinical guidelines for Long COVID were established relatively early for adults[8,9], consensus on pediatric-specific definitions emerged more recently. In 2022, a modified Delphi process proposed criteria specifically for children and adolescents[10], and in February 2023, the World Health Organization released an official definition of the post-COVID condition in these age groups[11]. The pathophysiology of long COVID is multifaceted and not yet fully elucidated. However, emerging evidence points towards a constellation of interconnected factors, such as immune dysregulation with possible viral persistence, disruption of the microbiota, the development of autoimmunity, endothelitis, metabolic dysfunction, and sequelae of intensive care[12-14].

Studies in adults indicate that risk factors for Long COVID include female sex, middle age, and certain comorbidities such as asthma[15-17]. However, data on pediatric Long COVID remain limited, partly due to variations in study design, follow-up intervals, and case definitions[18-20]. Emerging evidence suggests that children and adolescents can experience a variety of persistent symptoms, including respiratory, neurological, and psychological complaints, that can affect daily functioning[19]. Beyond the prevalence differences observed between adults and children, the global prevalence also showed significant continental variation, with lower rates in the USA and Europe compared to Asia [21]. This considerable inter-continental heterogeneity underscores the continued importance of region-specific research. In Thailand, only a few studies have addressed Long COVID in children[22,23], leaving substantial gaps in understanding its incidence, clinical features, and potential risk factors within this population.

In this context, we aimed to investigate the incidence and persistence of Long COVID in Thai children and adolescents. We also sought to identify demographic and clinical risk factors associated with prolonged symptoms, thereby contributing to a more comprehensive understanding of pediatric Long COVID and informing follow-up and management strategies in this age group.

METHODS

This single-center, retrospective, and prospective single-arm longitudinal cohort study was conducted at King Taksin Memorial Hospital, a tertiary care center in the Thonburi district of Bangkok, Thailand. The study period spanned October 2021 to February 2023, during which COVID-19 cases in Thailand were managed according to national guidelines. We included Thai children under 18 years of age who had confirmed SARS-CoV-2 infection by reverse transcription-polymerase chain reaction or a Food and Drug Administration -approved antigen test. The children were enrolled if they could be followed at 3, 6, and 9 months after acute infection. The exclusion criteria included inability to attend scheduled follow-up visits or complete telephone assessments, and the presence of any pre-existing medical condition that, in the investigator's clinical judgment, would directly interfere with the accurate assessment of persistent symptoms or developmental outcomes (e.g., significant developmental disorders, severe neurological impairment). Chronic stable conditions such as allergic diseases or congenital heart disease were not considered exclusionary. Written informed consent was obtained from parents or legal guardians and assent was obtained from children aged 7 years and older.

Baseline demographic and clinical data, including age, sex, weight, height, comorbidities, and acute infection severity, were extracted from

medical records. The severity of the acute phase was classified per the criteria of the National Institutes of Health[24]: asymptomatic (no symptoms despite a positive test), mild (upper respiratory symptoms without dyspnea or desaturation), moderate (lower respiratory involvement without hypoxia), and severe (lower respiratory involvement with oxygen saturation < 94% in room air). Information on antiviral therapy (Favipiravir) was recorded according to the Thai COVID-19 treatment guidelines at the time[25]. Children with comorbidities or moderate/severe symptoms were more likely to receive antiviral therapy and/or hospitalized.

Long COVID was defined as the presence of one or more symptoms persisting at least three months after SARS-CoV-2 infection[11]. Participants were evaluated at three points post-infection: 3, 6, and 9 months. The 3- and 9-month evaluations were conducted in person by a pediatrician, while the 6-month assessment was performed by telephone to reduce hospital visits. A symptom checklist was used to evaluate respiratory (rhinorrhea, dyspnea, cough), cardiovascular (chest pain, palpitations), gastrointestinal (abdominal pain, diarrhea, nausea/vomiting, appetite loss), neurological (headache, dizziness, tremors, sensory disturbances), musculoskeletal (joint or muscle pain), dermatological (rash, hair loss), and psychological symptoms (mood changes, anxiety, sleep disturbance). Parents or legal guardians reported symptoms in children under 6 years of age. Children 6 years and older were encouraged to self-report. Children under 6 years of age underwent developmental screening using the Developmental Surveillance and Promotion Manual (DSPM)[26]. DSPM assesses five domains: gross motor, fine motor, receptive language, expressive language, and social/self-help skills. A developmental quotient < 70 indicates delay. Participants aged 10 years and older underwent psychological assessment utilizing standardized instruments. Depressive symptomatology was evaluated using the Children's Depression Inventory (CDI-Thai version)[27], with a score of 15 or higher indicating clinically significant depression. Anxiety symptoms were assessed via the Screen for Child Anxiety Related Disorders (SCARED-Thai version)[28]; a total score of 25 or higher was considered suggestive of a potential anxiety disorder. Psychological screening was conducted at 3-month and 9-month follow-up visits. At each time point, participants aged 10 years and older were assessed using the CDI-Thai version and the SCARED-Thai version during their in-person evaluations.

For children aged 6 years and older, symptom self-reporting was encouraged during structured interviews conducted by pediatricians. Parents or guardians were present during the assessment to assist or clarify if needed. Responses were cross-checked with parental reports to enhance data reliability, and any discrepancies were resolved during the interview.

All analyzes were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation or median with interquartile range, depending on the data distribution. Categorical variables were presented as frequencies and percentages.

To identify factors associated with Long COVID, a univariate logistic regression was first conducted for variables of interest (age, sex, comorbidity, severity of acute infection and Favipiravir use). Variables with a p-value < 0.2 in the univariate analysis were included in the multivariate logistic regression. Adjusted odds ratio (OR) and corresponding 95% confidence interval (CI) were calculated to determine independent predictors. A two-sided p-value < 0.05 was considered statistically significant.

This study was approved by the Bangkok Metropolitan Administration Ethics Committee for Human Research (S008h/65). Written informed consent was obtained from the parents or legal guardians of all participants, and assent was obtained from children aged 7 years and older. The data was managed in compliance with institutional data-protection policies and the principles outlined in the Declaration of Helsinki.

RESULTS

A total of 233 children and adolescents (mean age 9.95 years, range 0.39-17.98 years) were enrolled (Table 1). Of these, 117 (50.22%) were female, and 49 (21.03%) had an allergic condition (e.g., asthma, allergic rhinitis, atopic dermatitis) or other comorbidity such as congenital heart disease, transfusion dependent beta thalassemia, HIV infection (CD4 > 350 cells/mm^3 with viral load suppression), hypertension, obstructive sleep apnea and psoriasis. During the acute phase, 30 children (12.88%) were asymptomatic, 184 (78.97%) had mild severity and 19 (8.15%) had moderate severity without the need for mechanical ventilation. Fifteen participants (6.44%) required hospital admission. According to the Thai COVID-19 treatment guidelines[20], 142 (60.94%) of the children received Favipiravir, primarily due to underlying comorbidities or moderate to severe presentations.

Follow-up data were available for all 233 participants at both 3- and 6-month assessments. At 3 months, 83 participants (35.62%) reported persistent symptoms, which decreased to 24 participants (10.30%) at 6 months. At 9 months, 125 of the original 233 participants (53.60%) returned for in-person evaluation, and no participants reported ongoing symptoms at that time (Figure 1).

Table 1 Descriptive characteristics

Descriptive Characteristics	Results (233) N (%)
Sex	
Male	116 (49.78%)
Female	117 (50.22%)
Age (years), median (IQR)	9.95 years (0.39-17.98)
Age range	
Infant (0-1 years)	10 (4.29%)
Toddlers (> 1-3 years)	12 (5.15%)
Preschool-aged children (> 3-5 years)	29 (12.45%)
School-aged children (> 5-10 years)	62 (26.61%)
Adolescents (> 10-18 years)	120 (51.50%)
Pre-existing comorbidity	
No	184 (79%)
Yes	49 (21%)
Family infection	
No	2 (0.86%)
Yes	231 (99.14%)
Treatment Place	
Covid ward	15 (6.44%)
Home isolation	108 (46.35%)
Hospital	97 (41.63%)
Community isolation	13 (5.58%)
Symptomatic COVID	
Asymptomatic	30 (12.88%)
Mild symptom	184 (78.97%)
Moderate symptom	19 (8.15%)
Favipiravir	
No	91 (39.06%)
Yes	142 (60.94%)

Abbreviations: IQR, interquartile range; N, number

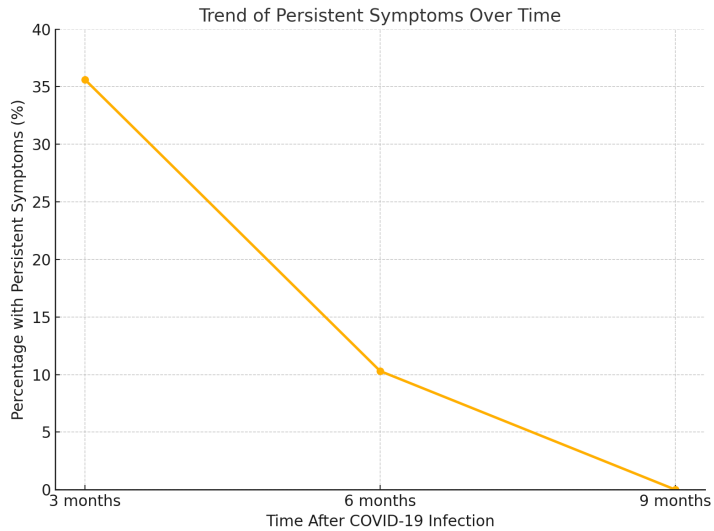

Figure 1 Trend of persistent symptoms among children and adolescents following SARS-CoV-2 infection at 3, 6, and 9 months

At three months, 65.06% of the participants reported 1-2 symptoms, the most frequently reported symptoms were dyspnea (34.94%), hair loss (33.73%), sleep disturbances (25.30%), rhinorrhea (22.89%) and fatigue (13.25%). At six months, 24 patients reported 3 or fewer symptoms, hair loss (37.50%), and sleep problems (25%) remained prominent, while overall respiratory complaints decreased (Table 2). Psychological symptoms, including anxiety and depressed mood, were also observed. Among those aged ≥ 10 years, self-report questionnaires revealed a higher prevalence of subclinical anxiety or depressive symptoms (Table 3).

Table 2 Persistent symptoms at 3 and 6 months after acute infection

Reported symptoms	3 months N = 83 (%)	6 months N = 24 (%)
Cardiorespiratory		
Cough	2 (2.41%)	1 (4.17%)
Sore throat	1 (1.20%)	0
Rhinorrhea	19 (22.89%)	2 (8.33%)
Dyspnea	29 (34.94%)	1 (4.17%)
Pleuritic chest pain	3 (3.61%)	1 (4.17%)
Chest pain	7 (8.43%)	0
Gastrointestinal		
Diarrhea	6 (7.23%)	0
Constipation	2 (2.41%)	0
Abdominal pain	6 (7.23%)	0
Neuropsychiatric		
Decrease attention	3 (3.61%)	1 (4.17%)
Depressed mood	3 (3.61%)	1 (4.17%)
Worry	2 (2.41%)	4 (16.67%)
Headache	10 (12.05%)	0
Balance problem	2 (2.41%)	0
Tremor	3 (3.61%)	0

Table 2 Persistent symptoms at 3 and 6 months after acute infection (continued)

Reported symptoms	3 months N = 83 (%)	6 months N = 24 (%)
Numbness	5 (6.02%)	2 (8.33%)
Dysosmia	4 (4.82%)	0
Fatigue	11 (13.25%)	1 (4.17%)
Sleep problem	21 (25.30%)	6 (25%)
Dizziness	6 (7.23%)	2 (8.33%)
Dermatological		
Rash	3 (3.61%)	0
Hair loss	28 (33.73%)	9 (37.50%)
Others		
Muscle weakness	8 (9.64%)	2 (8.33%)
Joint pain	1 (1.20%)	0
Fever	1 (1.20%)	0

Abbreviations: N, number

Table 3 Psychological screening in children > 10 years of age at 3 and 9 months

Screening tool	3 months (N = 120)	9 months (N = 55)
Positive screening for depression*	37 (30.83%)	14 (25.45%)
Positive screening for anxiety**	58 (48.33%)	25 (45.45%)

Abbreviations: N, number

*Children's Depression Inventory score ≥ 15

**Screen for Child Anxiety Related Disorders score ≥ 25

Table 4 shows that in the univariate analysis, older age (> 10 years), comorbidity, and moderate severity symptom were significantly associated with persistent symptoms at six months (OR 6.333 [95% CI: 1.426–28.128], p = 0.015; OR 3.808 [1.585–9.148], p = 0.003; OR 16.917 [1.873–152.771], p = 0.012), while female sex showed borderline significance (p = 0.094) and treatment with Favipiravir was not significantly associated (p = 0.869).

In the multivariate model, only children with symptoms of moderate severity remained significantly more likely to develop Long COVID at six months (adjusted OR 10.558, 95% CI: 1.010–110.326, p = 0.049). Age > 10 years retained borderline significance (adjusted OR 4.435, 95% CI: 0.958–20.527, p = 0.057), while comorbidity and female sex were no longer statistically significant in the fully adjusted model.

Table 4 Factors associated with Long COVID

Variables	Univariate logistic regression		Multivariate logistic regression	
	Odds Ratio (95% CI)	P-value	Adjusted Odds Ratio (95% CI)	P-value
Age 6-10 yr	0.663 (0.058,7.550)	0.740	0.558 (0.047, 6.557)	0.642
Age > 10 yr	6.333 (1.426,28.128)	0.015*	4.436 (0.958, 20.527)	0.059
Female	2.139 (0.877, 5.213)	0.094	2.403 (0.850, 6.794)	0.098
Any comorbidity	3.808 (1.585, 9.148)	0.003*	2.331 (0.829, 6.559)	0.109
Mild severity of acute infection	2.762 (0.353, 21.634)	0.333	2.564 (0.309, 21.244)	0.383
Moderate severity of acute infection	16.917 (1.873, 152.771)	0.012*	11.079 (1.042, 117.786)	0.046*
Favipiravir treatment	1.076 (0.450, 2.573)	0.869	0.633 (0.224, 1.792)	0.389

Abbreviations: CI, confidence interval; N, number; yr, year

*P- value < 0.05 indicated statistically significant.

Additional logistic regression analyses at the 3-month follow-up demonstrated consistent results regarding significant predictors (age > 10 years, female sex, and moderate severity of symptoms). Full details are available in the Table 5.

At nine months, 125 participants returned for in-person evaluations, and none reported persistent physical symptoms. Developmental screening among children < 6 years did not detect new delays. However, standardized screening for anxiety and depression continued to yield elevated scores in a subset of children aged ≥ 10 years (Table 3), underscoring the need for ongoing mental health monitoring, although these psychological findings did not necessarily meet clinical diagnostic criteria.

DISCUSSION

This study investigated the incidence and clinical presentation of Long COVID in Thai children and adolescents, identifying potential risk factors and examining the trajectory of symptoms over nine months. We found that 35.62% of the participants reported persistent symptoms at three months. This decreased to 10.30% at six months and no participant reported ongoing symptoms at nine months. These findings are consistent with previous reports demonstrating a wide variability in the prevalence of pediatric Long COVID, 1.60-70% depending on the study[18-20]. The other Thai studies, such as Wongwathanavikrom et al.'s report prevalence of 39.70% at 3 months in children after COVID pneumonia and Lokanuwatsatien et al.'s overall prevalence of 30.20% in a pediatric cohort with most asymptomatic to mild symptom in acute infection like our study[22-23]. This finding may support hypothesis that greater initial disease severity, potentially manifesting as increased lung involvement and inflammation, may contribute to a higher risk of developing long COVID. The decline in symptom prevalence at six months reflects a similar trend observed in other studies, where pediatric Long COVID symptoms tend to improve over time[19,22]. Our study found long COVID decreased to 10.30% at six months, with no symptoms at nine months. This is lower than the 20.64% prevalence at 6-12 months in those under 18 reported by Lopez et al.'s meta-analysis[19], and also lower than the 9.60% (3-6 months) and 6.90% (6-12 months) persistence seen in another Thai pediatric study[29]. The more rapid resolution in our cohort suggests a potentially different long COVID trajectory, though methodological differences should be considered.

Our results also highlight that moderate severity of symptoms during the acute phase of the illness, older age (> 10 years), and underlying comorbidities showed significant or borderline associations with persistent symptoms at six months. After adjusting for covariates, moderate symptom severity remained a significant independent risk factor for Long COVID,

Table 5 Factors associated with Long COVID symptoms at 3 months after COVID infection

Variables	Univariate logistic regression		Multivariate logistic regression	
	Odds Ratio (95% CI)	P-value	Adjusted Odds Ratio (95% CI)	P-value
Age 6-10 yr	2.026 (0.833,4.929)	0.120	2.057 (0.789, 5.361)	0.140
Age > 10 yr	3.146 (1.506,6.575)	0.002*	2.684 (1.202, 5.996)	0.016*
Female	2.730 (1.553, 4.797)	< 0.001*	3.460 (1.787, 6.700)	< 0.001*
Any comorbidity	1.425 (0.746, 2.724)	0.284	-	-
Mild severity of acute infection	4.800 (1.402, 16.435)	0.012*	7.929 (1.740, 36.145)	0.007*
Moderate severity of acute infection	19.500 (4.198, 90.573)	< 0.001*	54.353 (7.658, 385.766)	< 0.001*
Favipiravir treatment	1.412 (0.803, 2.481)	0.231	-	-

Abbreviations: CI, confidence interval; N, number; yr, year
*P- value < 0.05 indicated statistically significant.

consistent with prior research indicating that children with more severe acute illness may be at higher risk of prolonged recovery[30,31]. While older age retained borderline significance in the multivariate model, the lack of statistical significance for underlying disease contrasts with some studies reporting that comorbidities, especially asthma or allergic conditions, predispose children to persistent symptoms[22,31]. Discrepancies between our findings and those in the literature may be due to differences in patient populations, sample sizes, and specific comorbidities included.

A notably high proportion of participants reported hair loss (33.73% at three months and 37.50% at six months), surpassing the rates reported in other studies[19,23]. A possible explanation is stress-related telogen effluvium triggered by the illness itself or by psychosocial factors during the pandemic. Sleep disturbances also remained prominent at six months (25%), underscoring the potential impact of COVID-19 on children's mental health and daily functioning.

Psychological symptoms were another important finding, particularly among adolescents (≥ 10 years). Although few participants explicitly reported anxiety or depressive moods, self-report screening tools[27,28,32] revealed a higher prevalence of subclinical symptoms. This discrepancy suggests that routine mental health evaluation may be necessary, as children may not report emotional or behavioral changes. Pandemic-related disruptions, such as school closures and social isolation, may have amplified stress in this population[4-6].

Using the DSPM, we did not detect developmental delays in children under six years of age[26], supporting earlier research indicating that mild or asymptomatic COVID-19 might not substantially affect early developmental milestones[33]. Nonetheless, children with more severe illness could need longer-term monitoring to detect subtle cognitive or motor impacts.

This study has several limitations. Its single-center retrospective-prospective cohort design without a control group limits generalizability and introduces potential selection bias. The modest sample size and lack of predefined subgroup analysis calculations may compromise statistical power and stability of results. Attrition at nine-month follow-up (~46%) could lead to selection bias, impacting symptom prevalence accuracy. Data collection via phone interviews at six months, rather than in-person assessments, may introduce reporting bias. Additionally, the absence of viral genotyping and detailed vaccination status limits the evaluation of variant-specific effects and vaccine impact on outcomes. Psychological assessments were screening measures, potentially underestimating mental health burdens, and unmeasured socio-environmental factors might represent residual confounding. Nonetheless, the findings contribute valuable insights into pediatric Long COVID, emphasizing the need for close monitoring and routine psychological screening in post-COVID care.

CONCLUSION

In this single-center cohort of Thai children and adolescents, more than one-third experienced persistent symptoms at three months following SARS-CoV-2 infection, and around 10% continued to have complaints at six months. Moderate severity symptoms during the acute illness were a significant independent risk factor for Long COVID at six months. Clinicians should therefore prioritize follow-up and supportive care for children with moderate acute COVID-19, especially regarding physical and mental health monitoring.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

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DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

1. World Health Organization. WHO Coronavirus (COVID-19) dashboard [internet]. 2023 [cited 2025 Jan 11]. Available from: https://data.who.int/dashboards/covid19/cases
2. The Department of Disease Control Ministry of Public Health. COVID-19 patient situation in Thailand [internet]. 2022 [cited 2025 Jan 10]. Available from: https://ddc.moph.go.th/covid19-dashboard/?dashboard=main
3. Melgar M, Lee EH, Miller AD, Lim S, Brown CM, Yousaf AR, et al. Council of state and territorial epidemiologists/CDC surveillance case definition for multisystem inflammatory syndrome in children associated with SARS-CoV-2 infection – United States. MMWR Recomm Rep 2022;71(4):1-14.
4. Bliddal S, Banasik K, Pedersen OB, Nissen J, Cantwell L, Schwinn M, et al. Acute and persistent symptoms in non-hospitalized PCR-confirmed COVID-19 patients. Sci Rep 2021;11(1):13153.
5. Mandal S, Barnett J, Brill SE, Brown JS, Denneny EK, Hare SS, et al. 'Long-COVID': a cross-sectional study of persisting symptoms, biomarker and imaging abnormalities following hospitalisation for COVID-19. Thorax 2021;76(4):396-8.
6. Nalbandian A, Sehgal K, Gupta A, Madhavan MV, McGroder C, Stevens JS, et al. Post-acute COVID-19 syndrome. Nat Med 2021;27(4):601-15.
7. World Health Organization. A clinical case definition of post COVID-19 condition by a Delphi consensus, 6 October 2021. Geneva: World Health Organization; 2021.
8. Post covid syndrome guideline for healthcare professional [internet]. 2021 [cited 2025 Jan 6]. Available from: https://covid19.dms.go.th/Content/Select_Landding_page?contentId=157
9. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19 [internet]. 2020 [cited 2025 Jan 6]. Available from: https://www.nice.org.uk/guidance/NG188
10. Stephenson T, Allin B, Nugawela MD, Rojas N, Dalrymple E, Pinto Pereira S, et al. Long COVID (post-COVID-19 condition) in children: a modified Delphi process. Arch Dis Child 2022;107(7):674-80.
11. World Health Organization. A clinical case definition for post COVID-19 condition in children and adolescents by expert consensus, 16 February 2023. Geneva: World Health Organization; 2023.
12. Davis HE, McCorkell L, Vogel JM, Topol EJ. Long COVID: major findings, mechanisms and recommendations. Nat Rev Microbiol 2023;21(3):133-46.
13. Raveendran AV, Jayadevan R, Sashidharan S. Long COVID: an overview. Diabetes Metab Syndr 2021;15(3):869-75.
14. Haunhorst S, Bloch W, Wagner H, Ellert C, Krüger K, Vilser DC, et al. Long COVID: a narrative review of the clinical aftermaths of COVID-19 with a focus on the putative pathophysiology and aspects of physical activity. Oxf Open Immunol 2022;3(1):iqac006.
15. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, et al. More than 50 long-term effects of COVID-19: a systematic review and meta-analysis. Res Sq [preprint] 2021.
16. Sigfrid L, Drake TM, Pauley E, Jesudason EC, Olliaro P, Lim WS, et al. Long covid in adults discharged from UK hospitals after covid-19: a prospective, multicentre cohort study using the ISARIC WHO Clinical Characterisation Protocol. Lancet Reg Health Eur 2021;8(100186):100186.

17. Munblit D, Bobkova P, Spiridonova E, Shikhaleva A, Gamirova A, Blyuss O, et al. Incidence and risk factors for persistent symptoms in adults previously hospitalized for COVID-19. Clin Exp Allergy 2021;51(9):1107-20.
18. Pellegrino R, Chiappini E, Licari A, Galli L, Marseglia GL. Prevalence and clinical presentation of long COVID in children: a systematic review. Eur J Pediatr 2022;181(12): 3995-4009.
19. Lopez-Leon S, Wegman-Ostrosky T, Ayuzo Del Valle NC, Perelman C, Sepulveda R, Rebolledo PA, et al. Long-COVID in children and adolescents: a systematic review and meta-analyses. Sci Rep 2022;12(1):9950.
20. Zheng YB, Zeng N, Yuan K, Tian SS, Yang YB, Gao N, et al. Prevalence and risk factor for long COVID in children and adolescents: a meta-analysis and systematic review. J Infect Public Health 2023;16(5):660-72.
21. Chen C, Haupert SR, Zimmermann L, Shi X, Fritsche LG, Mukherjee B. Global prevalence of post-Coronavirus disease 2019 (COVID-19) condition or long COVID: a meta-analysis and systematic review. J Infect Dis 2022;226(9): 1593-607.
22. Wongwathanavikrom NB, Tovichien P, Udomittipong K, Palamit A, Tiamduangtawan P, Mahoran K, et al. Incidence and risk factors for Long COVID in children with COVID-19 pneumonia. Pediatr Pulmonol 2024;59(5):1330-8.
23. Lokanuwatsatien T, Satdhabudha A, Tangsathapornpong A, Bunjoungmanee P, Sinlapamongkolkul P, Chaiyakulsil C, et al. Prevalence and associating factors of long COVID in pediatric patients during the Delta and the Omicron variants. Front Pediatr 2023;11:1127582.
24. National Institute of Health. Coronavirus disease 2019 (COVID-19) treatment guidelines [internet]. 2021 [cited 2021 Sep 1]. Available from: https://www.covid19treatment guidelines.nih.gov/
25. The Department of Disease Control Ministry of Public Health. Guidelines on clinical practice, diagnosis, treatment, and prevention of healthcare-associated infection for COVID-19 [internet]. 2021 [cited 2021 Aug 15]. Available from: https://ddc.moph.go.th/viralpneumonia/eng/guideline_hcw.php
26. Sirithongthaworn S. The development of developmental surveillance and promotion Manual; DSPM. J Psychiatr Assoc Thailand 2018;63(1):3-12.
27. Trangkasombat U, Likanapichitkul D. The children's depression inventory as a screen for depression in Thai children. J Med Assoc Thai 1997;80(8):491-9.
28. Tangjittiporn T, Sottimanon A, Ularntinon S. Psychometric properties of the screen for child anxiety related disorders Thai version. Pediatr Int 2022;64(1):e15093.
29. Rattanawijit M, Samutpong A, Apiwattanakul N, Assawawiroonhakarn S, Techasaensiri C, Boonsathorn S, et al. Rates, risk factors and outcomes of complications after COVID-19 in children. Pediatr Infect Dis J 2025;44(5): 449-54.
30. Morello R, Mariani F, Mastrantoni L, De Rose C, Zampino G, Munblit D, et al. Risk factors for post-COVID-19 condition (Long Covid) in children: a prospective cohort study. EClinicalMedicine 2023;59:101961.
31. Osmanov IM, Spiridonova E, Bobkova P, Gamirova A, Shikhaleva A, Andreeva M, et al. Risk factors for post-COVID-19 condition in previously hospitalised children using the ISARIC Global follow-up protocol: a prospective cohort study. Eur Respir J 2022;59(2):2101341.
32. Behrens B, Swetlitz C, Pine DS, Pagliaccio D. The screen for child anxiety related emotional disorders (SCARED): informant discrepancy, measurement invariance, and test-retest reliability. Child Psychiatry Hum Dev 2019;50(3):473-82.
33. Tassanakijpanich N, Chumchuen K, Worachotekamjorn J, Laoprasopwattana K. Association between SARS-CoV-2 infection before the age of two and child development. Pediatr Res 2024.