COVID-19-associated croup severity in Australian children

The Omicron variant of SARS-CoV-2 has been linked to upper airway manifestations, including laryngotracheobronchitis, or croup.[1–3] Croup from any cause is a common reason for hospital presentation in children and can cause serious morbidity.[3]

The current literature examining COVID-19-associated croup mostly describes the differences in clinical course and outcomes between SARS-CoV-2 variants; there is little data comparing SARS-CoV-2 croup to other respiratory viruses.[1–5] Thus, we conducted an Australian single-institution observational study comparing the clinical features and outcomes between COVID-19-associated and non-COVID-19-associated croup.

All cases of croup (ICD10 J05.0) in children aged 0–9 years presenting to The Royal Children's Hospital Melbourne, a quaternary paediatric hospital in Victoria, Australia, between the first case of COVID-19 in Australia (25 January 2020) and 30 June 2022 were included. Clinical, demographic and laboratory data were retrospectively extracted from the organisation electronic medical record (Epic Systems, Verona, Wisconsin, USA). Medical charts of all SARS-CoV-2-positive patients and all patients admitted to the intensive care unit (ICU) were also manually reviewed to ensure accuracy and completeness. SARS-CoV-2 status was determined via PCR or documented rapid antigen test positivity.

To assess differences between non-COVID-19 and COVID-19-associated croup cases in age, hospital admission, length of stay and treatment, Pearson's χ^2 test and Fisher's exact test were applied for categorical variables, Mann-Whitney U test for continuous variables. ORs were determined with logistic regression adjusted for age and sex. The statistical programming language R was used for all analyses.[6] P values <0.05 were considered statistically significant.

There were 4786 presentations of children with croup; 228 (4.8%) were caused by SARS-CoV-2 (table 1). Children presenting with COVID-19-associated croup had a younger median age than those with non-COVID-19-associated croup (1.3 years vs 2 years, p<0.001).

Compared with non-COVID-19-associated croup, children with COVID-19-associated croup were more likely to be admitted to hospital (44.3% vs 20.8%, p<0.001) and more likely to require ICU admission (4.8% vs 0.7%, p<0.001). Patients with COVID-19-associated croup had a shorter median length of stay (6.8 hours vs 8.1 hours, p=0.003), although ICU length of stay, if required, was similar (28 hours vs 26.5 hours, p=0.568).

Furthermore, COVID-19-associated croup patients were more likely to require mechanical ventilation (1.8% vs 0.1%, p<0.001). There was a trend towards requiring epinephrine therapy in the COVID-19-associated group (13.2% vs 9.6%, p=0.097). No patients from either group required extracorporeal membrane oxygenation or died.

Similar to previous studies,[2 3] COVID-19-associated croup in our population appeared to be more severe than non-COVID-19-associated croup. However, our data also show a shorter median length of stay for COVID-associated croup. Without objective measures for disease severity, higher hospitalisation and treatment rates may be confounded by clinician factors, including the potential tendency to manage this novel illness more cautiously. Conversely, shorter lengths of stay may be attributed to pressures for earlier discharge in the context of increased hospital resource burden, especially since there are limited numbers of negative pressure isolation rooms used in the inpatient management of patients with SARS-CoV-2.

Further, healthcare system burdens mirror wider epidemiological data.[7] The majority of COVID-19-associated croup occurred in early 2022 (figure 1), following

Table 1 Demographics, admission data and treatment data for children presenting with COVID-19-associated and non-COVID-19-associated croup

	COVID-19-associated croup	Non-COVID-19-associated croup	P value
Demographic data			
Patients, n	228	4558	–
Male patients, n (%)	141 (61.8%)	2992 (65.6%)	0.269
Age (years), median (Q1-Q3)	1.3 (0.8–0.2)	2 (1.4–3)	<0.001
Admission data			
Discharged from ED, n (%)	127 (55.7%)	3611 (79.2%)	<0.001
Admitted to ward, n (%)	101 (44.3%)	947 (20.8%)	<0.001
Ward LOS (hours), median (Q1-Q3)	5.6 (2.8–10.1)	7.9 (5.1–13.9)	<0.001
Admitted to ICU, n (%)	11 (4.8%)	32 (0.7%)	<0.001
ICU LOS (hours), median (Q1-Q3)	28 (14–111.5)	26.5 (15–43.2)	0.568
Admission odds			
Ward admission, OR (95% CI)	2.67 (2.02 to 3.52)		<0.001
ICU admission, OR (95% CI)	6.02 (2.82 to 11.97)		<0.001
Treatment data			
Nebulised epinephrine, n (%)	30 (13.2%)	437 (9.6%)	0.097
Invasive ventilation, n (%)	4 (1.8%)	3 (0.1%)	<0.001
Death, n (%)	0 (0%)	0 (0%)	N/A

To assess age, hospital admission, length of stay and treatment, Pearson's χ^2 test and Fisher's exact test were applied for categorical variables, Mann-Whitney U test for continuous variables. ORs were determined with logistic regression adjusted for age and sex.
ED, emergency department; ICU, intensive care unit; LOS, length of stay.

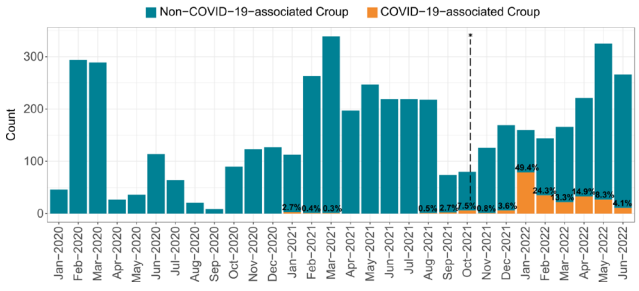

Figure 1 Croup presentations by month. This figure depicts the total number of croup cases that presented to hospital each month between the first case of COVID-19 in Australia in January 2020 to June 2022. The percentage values above COVID-19-associated croup bars denote the total percentage of croup cases in that corresponding month that were COVID-19 positive. *The vertical line denotes the easing of government-mandated movement restrictions on 21 October 2021.

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the easing of government-mandated restrictions during the predominance of Omicron, which has a predilection to cause croup over the Delta variant.[1–3]

These findings have implications for both clinicians and public health policy makers. Clinicians should exercise a higher degree of caution with children with croup who are SARS-CoV-2 positive, as these children may be at higher risk of severe illness. Morbidity from COVID-19-associated croup should further inform public health measures such as COVID-19 vaccination, particularly in younger children. As new variants of SARS-CoV-2 continue to emerge, croup is likely to remain an important manifestation of COVID-19 in children.

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Contributors TCL collected data, carried out initial analyses and interpretation, drafted the initial manuscript, and critically reviewed and revised the manuscript. PJBW and SS carried out data analyses and interpretation, and critically reviewed and revised the manuscript. AM collected data and critically reviewed and revised the manuscript. ST and NC critically reviewed and revised the manuscript. DRC conceptualised and designed the study and data collection instruments, carried out data analyses and interpretation, and critically reviewed and revised the manuscript.

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