RSV severity in New Zealand 2021 and 2022: applying the WHO severity assessment framework

David Broderick,[a,*] Isabella Cheung,[b] Janine Paynter,[b] Jane O'Donnell,[c] Steffen Albrecht,[d] Nayyereh Aminisani,[e] Adrian Trenholme,[a,f] Cameron C. Grant,[a,g] Sue Huang,[e] Nikki Turner,[b] Catherine A. Byrnes,[a,g] and Peter McIntyre[h]

[a]Department of Paediatrics Child and Youth Health, School of Medicine, The University of Auckland, Auckland, New Zealand
[b]Department of General Practice & Primary Healthcare, School of Population Health, The University of Auckland, Auckland, New Zealand
[c]Department of Anaesthesiology, School of Medicine, The University of Auckland, Auckland, New Zealand
[d]School of Computer Science, The University of Auckland, Auckland, New Zealand
[e]Institute of Environmental Science and Research (ESR), Wellington, New Zealand
[f]Kidz First Children's Hospital, Te Whatu Ora, Health New Zealand, Counties Manukau District, New Zealand
[g]Starship Children's Hospital, Te Whatu Ora, Health New Zealand, Auckland District, New Zealand
[h]Department of Women's and Children's Health, University of Otago, New Zealand

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Respiratory Syncytial Virus (RSV) causes a large burden of severe respiratory disease in the first two years of life and is increasingly recognised as an important contributor to deterioration of respiratory health in elderly populations.[1] Following the 2009 influenza pandemic, minor delays in the onset of peak RSV activity in temperate regions were identified, which persisted for three years.[2] Implementation of measures including border-closures, social distancing and face-mask use, was much greater following the SARS-CoV-19 pandemic in 2020. In Aotearoa New Zealand (NZ), RSV transmission was eliminated for 12 months.[3] In June 2021, following brief border-opening limited to Australia, RSV with an identical genotype to the circulating Australian strain, emerged in NZ with rapid onset of very high peak incidence.[3] Intense, out-of-season RSV transmission in the immediate post-COVID period has been observed in a wide range of countries, with hypotheses for this including immunity debt due to absent RSV transmission, interaction between SARS-CoV-2 and RSV and increased RSV virulence.[4] The NZ situation of RSV resurgence prior to community transmission of SARS-CoV-2 in 2022[3] can shed light on these competing hypotheses.

Accurate assessment of changes to the burden and severity of RSV across healthcare systems is complicated by lack of uniform surveillance case definitions and testing criteria over time.[5] Since 2012, NZ has had active population-based sentinel surveillance of severe acute respiratory infections (SARI) through a hospital network in Auckland, which captures all cases in the resident population during epidemiological weeks 18–40.[6] In the pre-pandemic period 2012–2019, this network identified peaks in RSV-SARI consistent in timing and incidence with other temperate regions.[7] The World Health Organization (WHO) Pandemic Influenza Severity Assessment (PISA) scale assesses epidemic severity and healthcare system impact through weekly incidence, proportion of SARI cases due to influenza and of these cases resulting in ICU admission or death against historical baseline thresholds.[8] We added to our previous analysis[7] by applying the PISA scale to the 2021 and 2022 RSV seasons compared to baseline data 2012–19.

We calculated weekly incidence of RSV-SARI cases and proportion of RSV-SARI to all SARI. Disease severity measurement was limited to the ratio of ICU-admitted to all RSV-SARI hospitalisations, with <10 in-hospital deaths recorded among RSV-SARI cases precluding meaningful analysis. The age groups used conform with PISA guidelines and capture hospitalisations in the very young and very old (Table 1). Data analysis was performed using the tidyverse, mem, and ggplot2 R (version 4.2.2) packages. The SHIVERS study was granted ethics committee approval by the NZ Northern A Health and Disability Ethics Committee (NTX/11/11/102).

In 2021 and 2022, RSV seasonal patterns were disrupted (Supplemental Figure S1). In 2021, across all age groups, RSV-SARI and proportion of SARI due to RSV exceeded extreme threshold levels, with peak weekly incidence up to 16 fold higher than baseline data. Coinfections were commonly identified in both pre and post pandemic periods–39% 2012–2019 versus 26% 2021 and 33% 2022–but SARS-CoV-2 coinfection in only a single RSV case in 2022. Patterns of RSV incidence (high intensity first wave, low intensity second wave) in New Zealand correspond to reports from Australia, Costa Rica and Japan.[9] Data comparing severity in two subsequent seasons are scarce. In New Zealand in 2021, ICU admission as a proportion resembled baseline, though absolute numbers during the peak were high, and was significantly lower in 2022 (Table 1). A similar pattern was seen in Australia,[10] but in British Columbia there was no change between years.[11]

*Corresponding author.
E-mail address: david.broderick@auckland.ac.nz (D. Broderick).

Age group (years)	Time period	RSV case numbers (Total SARI)	Incidence rate per 100,000 (95% CI)	Peak weekly incidence rate per 100,000 (95% CI)	Average weekly cases incidence rate per 100,000 (95% CI)	Weekly incidence threshold values[a]	Proportion SARI	Effect size	Threshold values[a]	Proportion ICU	Effect size	Threshold values[b]
All ages												
	2012–2019	2620 (14,083)	31 (31–34)	0.5 (0.4–0.7)	1 (0.8–1)	3, 4, 5	0.19		0.29, 0.38, 0.44	0.10		0.10, 0.13, 0.17
	2021	308 (1086)	28 (25–32)	6 (4–7)	1 (0.4–2)		0.28[c]	0.21		0.08	−0.07	
	2022	226 (2494)	21 (18–24)	1 (0.8–2.3)	0.6 (0.3–1)		0.09[c]	−0.29		0.02*	−0.36	
<1												
	2012–2019	1364 (3157)	890 (843–938)	16 (11–24)	27 (19–37)	78,110,129	0.43		0.66, 0.80, 0.87	0.13		0.13, 0.17, 0.25
	2021	135 (274)	1018 (854–1205)	264 (184–367)	31 (9–78)		0.49	0.12		0.09	−0.13	
	2022	108 (412)	821 (673–991)	68 (31–130)	25 (6–70)		0.26[c]	−0.36		0.02[c]	−0.45	
1≤2												
	2012–2019	483 (1358)	404 (369–442)	9 (5–16)	12 (7–20)	39, 58, 69	0.33		0.63, 0.91, 1	0.08		0.08, 0.13, 0.22
	2021	50 (136)	372 (276–490)	97 (51–165)	11 (1–48)		0.37	0.08		0.08	0	
	2022	52 (286)	402 (301–528)	39 (13–90)	12 (1–51)		0.18[c]	−0.35		0	−0.57	
2≤5												
	2012–2019	286 (1196)	78 (69–88)	2 (1–5)	3 (1–5)	8, 15, 20	0.24		0.45, 0.79, 1	0.107		0.10, 0.14, 0.23
	2021	52 (140)	126 (94–166)	27 (13–48)	4 (0.3–16)		0.37[c]	0.28		0.12	0.04	
	2022	41 (256)	102 (73–138)	12 (4–29)	3 (0.2–15)		0.16[c]	−0.20		0.07	−0.13	
5≤15												
	2012–2019	52 (673)	5 (4–6)	0.3 (0.1–1)	0.2 (0.003–0.7)	1, 2, 2	0.08		0.22, 0.52, 0.68	0.17		NA
	2021	10 (35)	7 (3–13)	2 (0.4–6)	0.3 (0–3)		0.29[c]	0.56		0.2	0.08	
	2022	4 (136)	3 (1–7)	1 (0.2–5)	0.1 (0–3)		0.03	−0.23		0	−0.85	
15≤65												
	2012–2019	52 (3944)	3 (3–4)	0.1 (0.1–0.3)	0.1 (0.005–0.3)	0, 1, 1	0.05		0.1, 0.19, 0.24	0.04		0.05, 0.10, 0.20
	2021	10 (255)	4 (3–6)	1 (1–2)	0.2 (0.007–0.8)		0.13[c]	0.29		0	−0.40	
	2022	4 (680)	1 (1–3)	0.3 (0.03–1)	0.05 (0–0.6)		0.02[c]	−0.17		0	−0.40	
65≤75												
	2012–2019	103 (1395)	20 (16–24)	1 (0.2–2)	1 (0.02–2)	2, 5, 7	0.07		0.19, 0.34, 0.44	0.03		NA
	2021	10 (89)	13 (6–24)	5 (1–13)	1 (0–6)		0.11	0.14		0	−0.35	
	2022	6 (275)	8 (3–17)	1 (0.03–7)	0.3 (0–5)		0.02[c]	−0.25		0	−0.35	
>75												
	2012–2019	138 (2088)	39 (33–46)	1 (0.5–3)	2 (0.6–4)	5, 8, 10	0.07		0.17, 0.32, 0.41	0.02		NA
	2021	18 (136)	33 (20–53)	7 (2–18)	1 (0.01–10)		0.13[c]	0.20		0	−0.28	
	2022	4 (404)	7 (2–18)	2 (0.05–3)	0.3 (0–7)		0.01[c]	−0.34		0	−0.28	

[a]Threshold values for moderate, high and extreme activity levels for peak weekly incidence and proportion of SARI cases representing 40%, 90% and 97.5% of the confidence intervals as assessed by the geometric mean of baseline data. [b]Threshold values for moderate, high and extreme activity levels for proportion of cases in ICU reflecting the mean, mean + 1 and mean + 3 standard deviations of baseline data. [c]Significantly different ($p < 0.05$) when compared to 2012–2019.

Table 1: **Number and proportions of RSV-SARI cases at New Zealand sentinel surveillance hospitals and in intensive care units across pre- and post-covid time periods.**

Strengths of our study are consistent case ascertainment and testing practices in a well-defined population, limiting potential bias from increased surveillance, postulated as explaining changes in RSV case counts following the pandemic in other studies.[12] Limitations include the PISA scale being limited to ICU admission, which may not capture severe disease in the very elderly because of different admission criteria, and changes in ICU admission being more difficult to statistically evaluate in a small population.

Our study with consistent testing practices in a population-based sentinel hospital cohort with SARS-CoV-2 community transmission only in 2022, makes other factors potentially contributing to changes in RSV epidemiology such as changes health seeking behaviour, primary healthcare access, testing practices and SARS-CoV-2 coinfection unlikely.[4] However, immunity debt, due to lack of circulating RSV in 2020, could explain the increased impact of RSV-SARI we observed in 2021, as lack of exposure would increase the susceptible population and reduce passive transfer of maternal antibodies via the placenta and in breastmilk.[4] The lower rates for older and very young in the 2022 season compared to baseline may be explained by high levels of infection-acquired immunity generated in 2021. Importantly, staggered viral re-emergence in NZ, with no community transmission of influenza or SARS-CoV-2 until 2022 due to prolonged general border closure, may have reduced the impact of seasonal viruses on the healthcare system. In contrast, countries where RSV and influenza epidemics coincided with COVID-19, such as the USA, the "tripledemic", magnified overall healthcare system burden.[13]

Contributors

DB: conceptualization, formal analysis, methodology, writing (original draft); IC: methodology, writing (review and editing); JP: methodology, writing (review and editing); JO'D: writing (review and editing); SA: writing (review and editing); NA: data curation, writing (review and editing); AT: writing (review and editing); CCG: writing (review and editing); SH: conceptualization, methodology, project administration, funding acquisition, writing (review and editing); NT: project administration, funding acquisition, writing (review and editing); CAB: project administration, supervision, writing (review and editing); PM: conceptualization, methodology, project administration, supervision, writing (review and editing). The funders have had no role in study design, data analysis and interpretation and that all authors have reviewed the manuscript.

Declaration of interests

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanwpc.2024.101221.

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