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Respiratory syncytial virus hospitalisation burden in children below 18 years in six European countries (2016-2023) pre- and post-COVID-19 pandemic

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ABSTRACT

Objectives: Respiratory syncytial virus (RSV) is a substantial cause of hospital admission in young children and leads to seasonal pressure on pediatric emergency units in most countries. This study aims to assemble national or large-scale data on RSV hospitalisations from six European countries with a standardised approach to provide recent burden data for all children and assess changes since SARS-CoV-2's emergence.

Methods: We analysed 2016-2023 hospital records from national registries in Denmark, England, Finland, The Netherlands, and Scotland, and from a hospital surveillance network in Spain-Valencia for children below 18 years. We considered separately RSV-coded and RSV laboratory-confirmed cases, comparing them to respiratory tract infections. We studied the temporal evolution of incidence rates and case reporting practices, comparing pre- and post-COVID-19 periods.

Results: Post-COVID-19 observed RSV hospital burden was similar to the pre-COVID-19 one for younger children but higher for the 1-2 years, 3-4 years, and 5-17 years age groups. No change in terms of coding—neither diagnosis nor RSV-coding when RSV was laboratory-confirmed—was detected.

Conclusions: Hospital RSV burden in children is significant but currently not fully monitorable. Further efforts to harmonise coding practices both within and across countries would improve the quality of future analyses. Additional data in future seasons should complement current outcomes to inform decisions regarding RSV prevention.

Introduction

Human respiratory syncytial virus (RSV) is a common cause of acute respiratory infections and can lead to severe outcomes in all infants [1–3]. RSV infection is nearly universal by the age of

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2 years, with around 50% of the infections occurring in infants below 6 months. Most recent global RSV disease burden estimates highlight that RSV causes approximately 33 million cases of lower respiratory tract infections (LRTIs) worldwide in children below 5 years, leading to around 3.6 million hospitalisations and approximately 100,000 attributable deaths [3]. However, these figures are likely underestimates because RSV testing is not always systematic in clinical practice [4–6].

As part of the Innovative Medicines Initiative funded REspiratory Syncytial virus Consortium in EUrope (RESCEU) project, we assembled routinely collected RSV healthcare data (2001-2017) to develop disease burden estimates, including underreporting of RSV in hospitalised children in seven European countries, to inform policymaking and regulatory decisions [4]. Updating these estimates has become a priority due to major changes in the RSV epidemiology and the immunisation landscape in recent years. First, the emergence of the SARS-CoV-2 virus and the related non-pharmaceutical interventions (NPIs) significantly impacted the circulation of all seasonal respiratory viruses including RSV-related infections [7,8] and hospitalisations [9–16]. Second, the preventive landscape of RSV has evolved over recent years significantly, with two new products for RSV immunisation receiving regulatory approvals and being progressively introduced into national immunisation programmes since autumn 2023. We aimed to gather the most updated estimates for RSV disease burden in six European countries including the period post-COVID-19 to support evidence-based decision-making. Through the international, private-public "Preparing for RSV Immunisation and Surveillance in Europe" (PROMISE) partnership, we analysed RSV hospitalisations from Denmark, England, Finland, The Netherlands, Scotland, and a region of Spain between 2016 and 2023.

Material and methods

Study design

We conducted an evaluation of respiratory tract infections (RTI) admissions, RSV-coded admissions, and RSV laboratory-confirmed admissions from routinely collected hospital databases from five countries (Denmark, England, Finland, The Netherlands, and Scotland), and from a regional hospital-based surveillance network in Valencia, Spain during the 2016-2023 surveillance seasons.

Data

Hospital admissions were identified based on International Classification of Diseases, Tenth Revision (ICD-10) codes (Table S1), except in Spain-Valencia, where all hospital admissions via emergency room that met predefined age-specific criteria (see supplementary material Spain-Valencia section) were included. The following hospitalisation types were defined:

(i) RTI-coded admissions: hospital admissions with any ICD-10 code related to an RTI or meeting criteria for Spain-Valencia.
(ii) RSV-coded admissions: a subset of RTI-coded admissions including all admissions with an RSV-specific ICD code: J12.1, J20.5, J21.0, B97.4 ICD-10 codes for admissions in Denmark, England, Finland, The Netherlands, and Scotland, and these ICD-10 codes plus 4801, 46611 and 0796 ICD-9-CM codes for Spain-Valencia.
(iii) RSV-confirmed admissions: hospitalised patients with a recorded positive RSV polymerase chain reaction test, if performed within −7 to +2 days of the hospitalisation. This data was only available for some countries (Denmark, Finland, Scotland, and Spain-Valencia).

Hospital admission was defined as any hospitalisation lasting more than 12 hours (8 hours in Spain-Valencia, any duration for England). Scheduled or routine admissions were excluded. Hospital admissions within 28 days following a previous admission for the same diagnosis were excluded (30 days in Spain-Valencia). A hospital admission was considered completed upon hospital discharge or death.

Each of the hospitalisation types was classified depending on their diagnosis into the following diagnosis groups: upper respiratory tract infection (URTI) and lower respiratory tract infection (LRTI), further stratified as bronchitis & bronchiolitis, pneumonia & influenza, SARS-CoV-2, or unspecified LRTI (Table S1).

Intensive care unit (ICU) admissions data were collected for England and mortality data for Denmark, England, and Finland. Mortality data included all admissions with a hospital death outcome that had an RTI-related cause of death (Table S1 details leveraged ICD codes). In Denmark and Finland, hospitalised patients were also monitored 14 days after their discharge.

High-risk patients were identified in Denmark, England, Finland, and Spain-Valencia. Risk factors were classified by age: <1 year, 1-4 years, and older children. A patient was defined as high-risk if meeting any of the identified criteria (list of risks per country in Table S2 and associated codes in Table S3). Data availability regarding risk factors was heterogeneous among countries so we only present outcomes in the supplementary material for readership interested in the evolution over the years for one given country.

Study period

The study period was split by surveillance years, defined starting from ISO week 27 of one year to ISO week 26 of the following year to include all hospitalisations during the winter period, which spans 2 calendar years in European countries. In Spain-Valencia, the study period was limited to the RSV circulation period(s) (Table S0). The study period started from 2016/2017 (2017/2018 for England and Scotland). 2016/2017 was a surveillance year already present in previous work [4] but was reanalysed to facilitate comparison for the countries with the same settings in PROMISE and RESCEU. The most recent season included in this analysis differs depending on data availability, which was country-specific.

To evaluate the impact of COVID-19, we stratified analyses by pre- and post-COVID-19 periods. The pre-COVID-19 period was defined from 2016 (2017 for England and Scotland) to 2019. The post-COVID-19 period was defined as all seasons starting in 2021/2022. 2019/2020 and 2020/2021 were excluded from this impact analysis due to the strong NPIs in place which resulted in severely reduced RSV transmission, making these seasons not representative of the short-term future.

Data analysis

Data were analysed and stratified by age groups: 0-2 months, 3-5 months, 6-11 months, 1-2 years, 3-4 years, and 5-17 years. Age was defined as the patient's age at the time of hospital admission. The in-hospital length of stay in days was calculated from admission to discharge date. It included any ICU stay or transfer to another hospital. Median and interquartile ranges were calculated. Denmark, Finland, The Netherlands, and Scotland could not provide real counts when the associated number was between 1-4 due to data privacy. In these cases, the final number was artificially set to 2.

Rates for RTI admissions, RSV-coded admissions, and RSV-confirmed admissions were calculated using the 1st of January population data (Denmark, Finland, The Netherlands, and Spain-Valencia) or mid-year population (England, Scotland). For 0-1 year,

even distribution of the population was assumed for sub-groups: 25% for 0-2 months, 25% for 3-5 months, and 50% for 6-11 months. In Spain-Valencia, the population was multiplied by the RSV circulation duration in years in each surveillance year to compensate for the difference in active surveillance duration between seasons (Table S0). In Scotland and England, no population data for the 2022/23 season were available, so the population was assumed to be the same as for the 2021/22 season. Rates were computed per 1000 person-years. Diagnoses associated with RSV-coded and RSV-confirmed hospitalisations were analysed by computing the relative frequency of each diagnosis per season and per age group.

On top of the descriptive metrics (number of hospital admissions, admission incidence rates), we computed the average incidence rates by hospitalisation outcome, hospitalisation type, country, and age group pre- and post-COVID-19 and we implemented a "ChangeProxy" metric, defined as the change in incidence rate between the post- and pre-COVID-19 periods, weighted by the pre-COVID-19 incidence. We performed Kruskal-Wallis tests to assess any difference between countries; we also performed Kruskal-Wallis tests on the observed incidence rates to assess variability due to SARS-CoV-2 emergence, per hospitalisation outcome, type, and age group. Spain-Valencia data were not included in these tests to avoid introducing potential biases due to changes in hospital policies post-COVID-19, and The Netherlands data were also not included due to lack of post-COVID-19 data.

Country-specificities (detailed description in Supplementary Material, including a visual overview Figure S0)

Denmark

Hospitalisation data were collected from the exhaustive Danish National Patient Registry, where mandatory primary diagnosis and optional secondary diagnoses are recorded. Risk group variables for infants were collected from the Medical Birth Register (MBR). Linkage to RSV-positive laboratory confirmations was performed using the KIDS database (Statens Serum Institute). No information on SARS-CoV-2 was available.

England

Data were collected from the England Hospital Episode Statistics (HES) database, capturing ≥98% of English hospitalisations, and where up to 20 diagnoses are recorded. When patient age was missing, it was approximated using information from other admissions for the same individual. If not available (<0.1%), they were accounted for only in the "Overall" age group. Risk factors were identified for each patient using all HES admissions, including non-RTI admissions.

Finland

Data were collected from a nationwide register maintained by the Finnish Institute for Health and Welfare (THL): the Finnish Care Register for Health Care (HILMO), which covers individual-level clinical and administrative data from inpatient care, specialised outpatient care, and day surgeries. The Finnish National Infectious Diseases Registry captures primary and secondary diagnoses, as well as all records of selected microbiological findings. Risk group variables for infants were collected from the Medical Birth Register (MBR), available only for the years 2018-2020.

The Netherlands

Data were collected from the Dutch Hospital Data (DHD) LBZBASISTAB and LBZDIAGNOSENTAB databases for the years 2016 to 2021. Linkage to RSV-positive confirmations was not possible.

Scotland

The Scottish Morbidity Record (SMR01) and Electronic Communication of Surveillance in Scotland registries were used, containing all inpatient and day cases in hospitals and laboratory-confirmed cases. We used the continuous inpatient stay marker to group admissions belonging to the same episode. Available age groups for children were country-specific: 0-1 years and 2-4 years.

Spain-Valencia

Data were collected through the Valencia Hospital Surveillance Network for the Study of influenza and other Respiratory Viruses (VAHNSI), an active prospective hospital-based surveillance network (∼1 million catchment population; 21% of the total Valencia population). During the study period, one of the four hospitals stopped participating and was replaced by another. Inclusion criteria are detailed in the supplementary material. All included patients were tested for RSV. The impact of partial monitoring during the surveillance year was assessed, and the loss of RSV-confirmed cases after adjusting the data to the circulation period seasons was negligible.

Results

RSV-coded represented between 3.9% (England, pre-COVID-19 period) and 24.7% (Spain-Valencia, pre-COVID-19 period) of all RTI-coded hospitalisations in children ≤18 years old and RSV-confirmed cases between 11% (Scotland, pre-COVID-19 period) and 35.5% (Spain-Valencia, pre-COVID-19 period) (Table 1). This proportion fluctuated between 4% and 11% depending on the country between pre- and post-COVID-19 era, in the same magnitude for coded and confirmed cases.

Table 1
Overview of the number of children below 18 years and of the number of RTI hospital admissions, RSV-coded admissions, and RSV-confirmed admissions among this population, per area and per period: pre- and post-COVID-19. Shown are the average per surveillance year observed during pre- and post-COVID-19 periods. For the population, the variation of the population during each period is presented as the standard deviation in brackets, expressed as a percentage of the average number of children. For RSV-coded and RSV-confirmed hospital admissions, the brackets present the average number of this category of admissions compared to the average number of RTI admissions, as a percentage.

Country	COVID-19 era	Population N (± SD, in %)	RTI N	RSV-coded N (% RTI)	RSV-confirmed N (% RTI)
Denmark	Pre	1,164,702 (±0.3%)	8989	928 (10.3%)	1084 (12.1%)
	Post	1,151,729 (NA)	10,219	1773 (17.4%)	2384 (23.3%)
England	Pre	11,910,788 (±0.4%)	218,143	8568 (3.9%)	NA
	Post	11,774,602 (NA)	213,538	21,516 (10.1%)	NA
Finland	Pre	1,065,419 (±0.5%)	8352	1215 (14.5%)	1366 (16.4%)
	Post	1,030,854 (±0.5%)	8728	1575 (18%)	1811 (20.8%)
The Netherlands	Pre	3,382,650 (±0.6%)	23,491	2222 (9.5%)	NA
Scotland	Pre	1,029,426 (±0.1%)	17,984	1630 (9.1%)	1984 (11%)
	Post	1,024,981 (NA)	14,725	1886 (12.8%)	2330 (15.8%)
Spain-Valencia	Pre	80,866 (±13%)	561	139 (24.7%)	199 (35.5%)
	Post	82,590 (±12%)	269	37 (13.8%)	67 (24.9%)

NA, not applicable, RSV, respiratory syncytial virus, RTI, respiratory tract infection.

RSV-coded hospital admissions incidence ranged from no incidence (2020/2021, Finland, 0-2 months, 3-5 months, and 3-4 years, 2016/2017 to 2019/2020 and 2021/2022, Spain-Valencia, 5-17 years) to 108 hospital admissions per 1000 children per surveillance year (Spain-Valencia, 2017/2018, 0-2 months) (Figure 1 for common age groups, Figure S2 for Scotland specific age groups). When excluding the two seasons with strong NPIs and low RSV circulation, 2019/2020 and 2020/2021, the mean incidence across the six countries was 38.6 ± 23.6 RSV-coded hospital admissions per 1000 children per surveillance year for 0-2 months, 21.0 ± 13.1 for 3-5 months, 6.6 ± 3.5 for 6-11 months, 2.0 ± 1.3 for 1-2 years and 0.4 ± 0.4 for 3-4 years. For RSV lab-confirmed, it ranged from no incidence (Finland, 2020/2021, 0-2 months, 3-5 months, 6-11 months, and 3-4 years, 2016/2017, 2017/2018, 2019/2020, Spain-Valencia, 5-17 years) to 111 hospital admissions per 1000 children (Spain-Valencia, 2018/2019, 0-2 months), with a mean of 14±22. In all age groups and countries—except Spain-Valencia where monitoring was paused in 2020/2021—hospital burden for all respiratory viruses in children below 5 years decreased substantially in the 2020/21 season, for both RSV-coded and RSV-confirmed. For 0-2 months, 3-5 months, and 6-11 months, the documented RSV burden on hospital inpatient services (coded and lab-confirmed) returned from the 2021/2022 season to levels like those observed pre-COVID-19, except in Spain-Valencia where it was observed to be lower. Denmark, England, and Finland showed higher incidence rates from 2021/2022 for children aged 1-2 years; England and Fin-

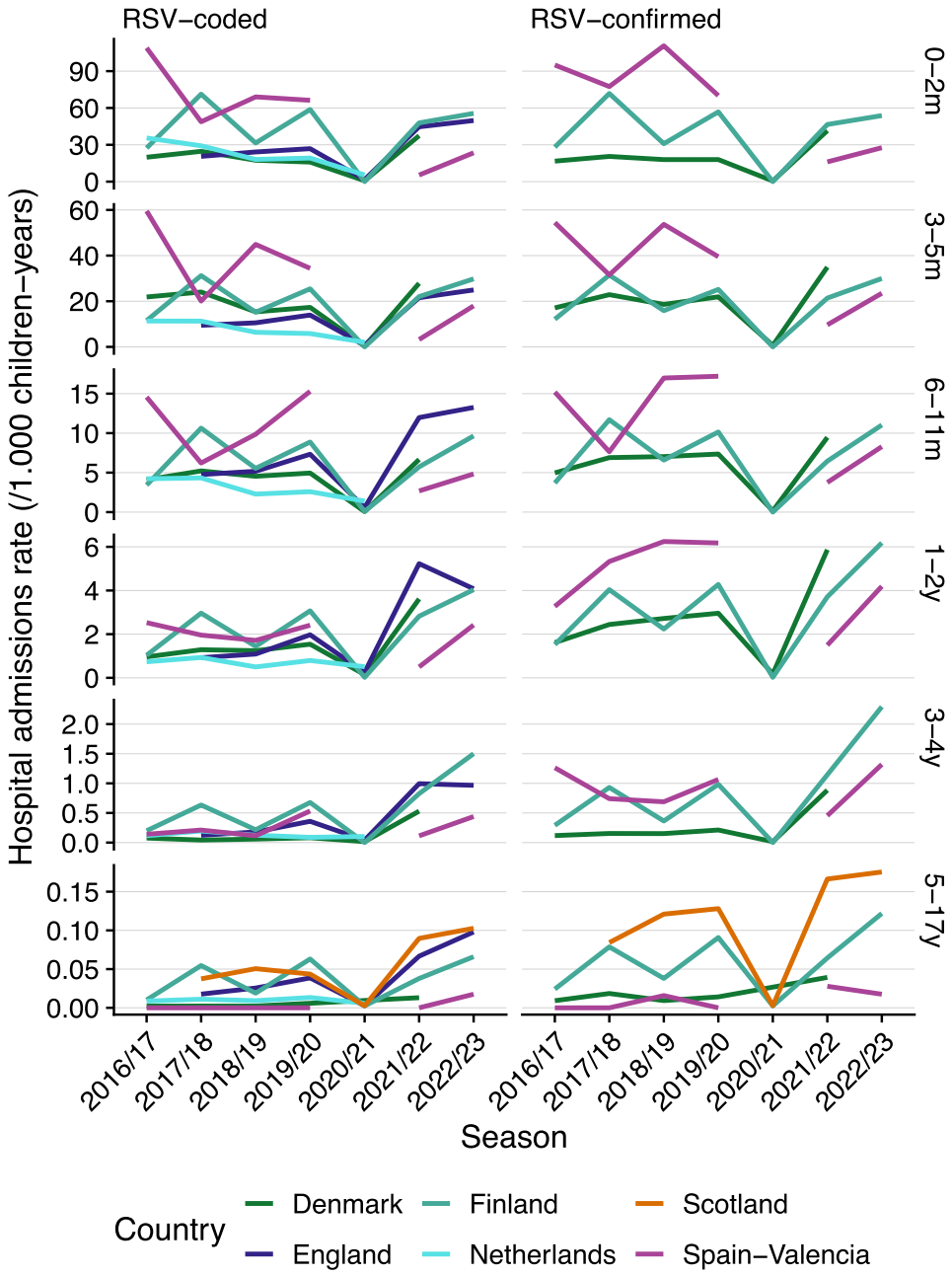

Figure 1. Hospital admissions rates in children below 18 years of age. The incidence of hospital admissions per 1000 children-years of the same age (y-axis) per surveillance year (x-axis) is shown for each country (colour), age group (vertical subpanels), and each hospitalisation type (rows): (i) all RSV-coded admissions and (ii) laboratory-confirmed RSV admissions. Note that each individual panel has a different y-axis scale to allow for readability and that for Spain-Valencia, no data was collected in 2020/2021. m, months; RSV, respiratory syncytial virus; y, years.

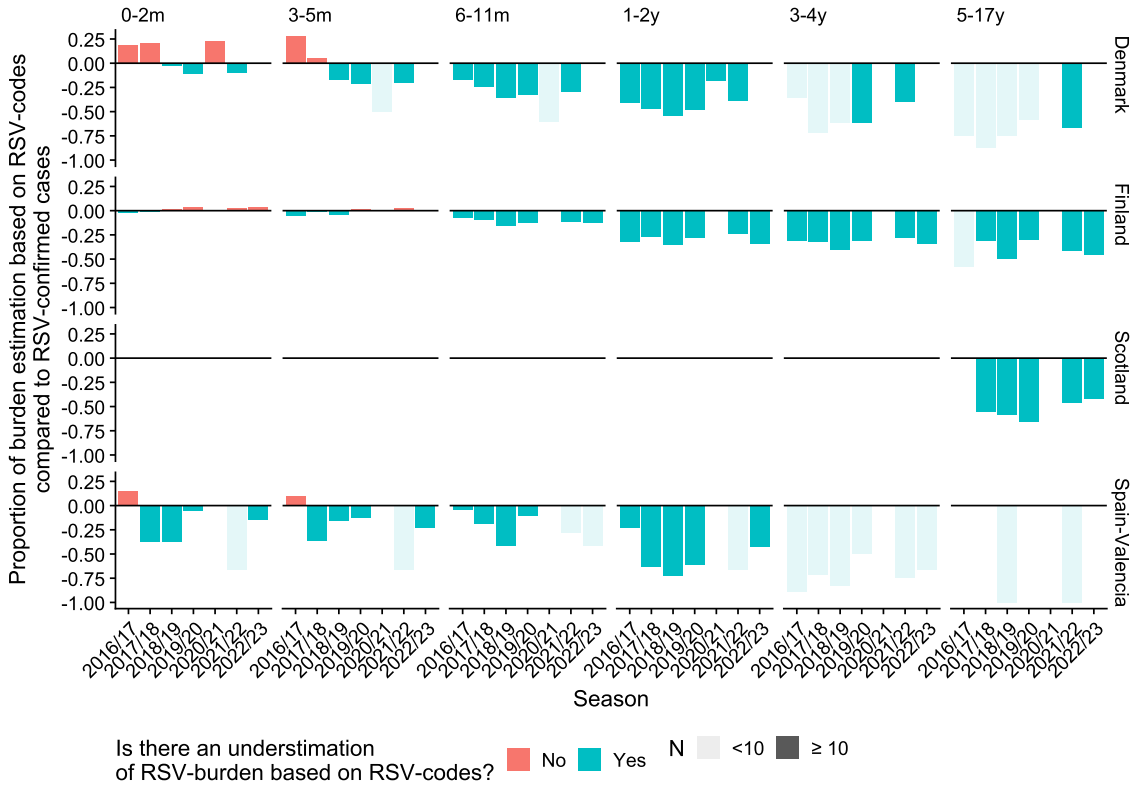

Figure 2. Evaluation of the evolution of RSV-coding practice compared to RSV-confirmation practice per country and season, computed as the proportion of RSV-coded cases that are RSV-confirmed, centred on 0 for readability (y-axis). For example, if the metric is equal to 0.25, it means there are 25% more RSV-coded hospital admissions than RSV-confirmed hospital admissions. This metric was computed by surveillance year (x-axis), by age group (vertical sub-panels), and by country (horizontal sub-panels). Bars with a pale colour indicate less robust data as there were fewer than 10 hospital admissions for that season and that country. Colours indicate if there is an underestimation (blue: yes, and red: no) to facilitate readability.
m, months; RSV, respiratory syncytial virus; y, years.

land also for children aged 3-4 years, and England, Finland, and Scotland for children aged 5-17 years (Table S4).

RSV-coded ICU admissions represented on average 9% (SD = 6%, min = 2, max = 25) of RSV-coded hospital admissions. RSV-coded deaths following a hospital episode (Denmark, Finland) and/or during hospitalisation (England) represented 0.6% of hospitalisations on average (SD = 3.7, min = 0, max = 40) in children below 5 years. Exhaustive multi-country evaluation of ICU admissions and deaths was not possible due to missing data. Available data can be found in Table S4.

Overall, across all countries, there were more RSV-confirmed cases than RSV-coded hospital admissions except for infants below 6 months, and for Finnish 6-11 months infants in 2020/2021 (Figure 2). Figure 2 does not show a change following SARS-CoV-2 emergence.

In Figure 3, the percentage of admissions by diagnosis group is shown for each country, age group, hospitalisation type, and surveillance year. Variability by age group, hospitalisation type, and across countries was observed. We observed a high proportion of bronchitis & bronchiolitis diagnoses in children ≤3 years; however, with increasing age and starting at 1 year, ICD coding for pneumonia & influenza substantially increases in frequency.

Bronchitis & bronchiolitis represented 88 ± 12% of diagnoses for 0-2 months, 3-5 months, and 6-11 months, 63 ± 15% for 1-2 years, and 50 ± 19% for 3-4 years considering both RSV-coded and RSV-confirmed patients. We observed some country-specific outcomes: 0-2 months Danish infants had a bronchitis & bronchiolitis diagnosis rate lower than in other countries, counter-balanced by more RSV cases coded as pneumonia. In England, we observed that bronchitis & bronchiolitis were less diagnosed for children 3-4 years than in other countries, in comparison with other diagnoses.

We observed a difference between RSV-coded and RSV-confirmed admissions for URTI diagnosis. In Denmark, a higher proportion of URTI diagnoses was observed when hospital admissions were RSV-confirmed (16 ± 6%) compared to RSV-coded (2 ± 3%). This trend was similarly seen but was less marked in Scotland (27 ± 15% vs 17 ± 14%) and Finland (8 ± 10% vs 3 ± 7%)—this is mostly due to the data in the 5-17-year age group where 13% of RSV-coded diagnoses were URTI diagnoses on average over seasons vs less than 2% in other age groups. In contrast, URTI diagnoses were present in England and The Netherlands among RSV-coded hospital admissions, but there were no RSV-confirmed cases to compare. In Spain-Valencia, we observed the opposite: a higher frequency of URTI diagnoses among RSV-coded (39 ± 53) than among RSV-confirmed admissions in Spain-Valencia (13 ± 13%), with for both cases a high variability. Regarding the impact of COVID-19, some differences in diagnosis classifications were observed during 2020/21 but in the following year(s) pre-COVID-19 patterns of diagnosis were observed. Any relevant change in diagnosis group classification will need to be assessed with more data post-COVID.

No significant difference was observed comparing pre- and post-COVID-19 incidences considering all age groups and countries together, for any of the hospitalisations and any of the hospitalisation outcomes. There was also no significant difference in the evolution of the RSV hospitalisation burden post-COVID-19 compared to pre-COVID-19 due to country-specificities. But, when assessing differences per age group, we observed statistically significant differences for all RSV-coded hospital admissions, and for all hospitalisation types for children aged 1-2years and 3-4 years (Table 2). For these two age groups, this pre-post-COVID-19 difference is not the same depending on the hospitalisation type (p-value <0.001).

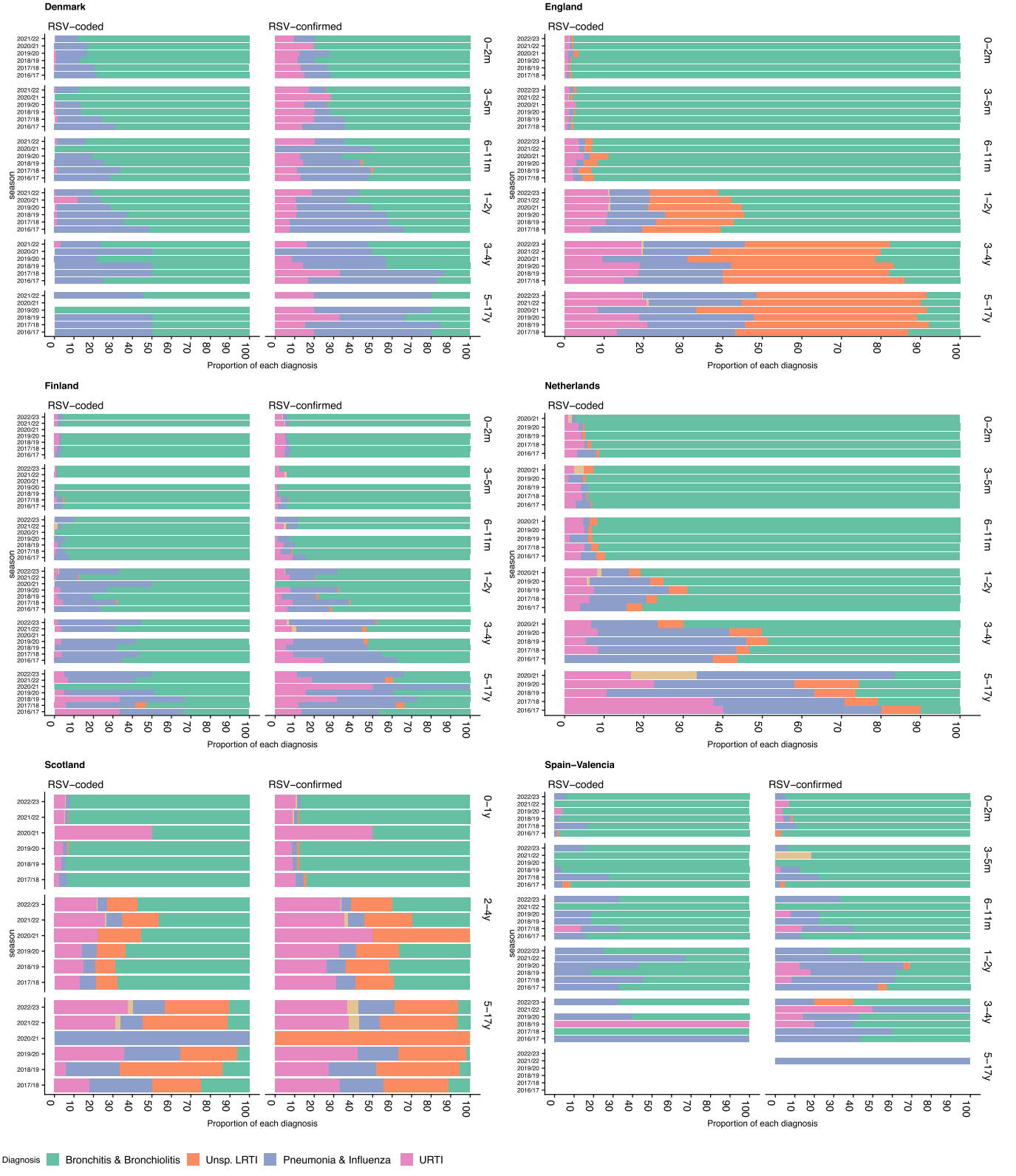

Figure 3. Percentage of each group of diagnosis per country, hospitalisation type, and age group. Diagnosis groups are bronchitis & bronchiolitis (green), pneumonia & influenza (blue), other LRTIs (orange) and URTIs (pink).
LRTI, lower respiratory tract infection; RSV, respiratory syncytial virus; URTI, upper respiratory tract infection.

Table 2
Outcomes of the Kruskal-Wallis test assessing a difference in incidence pre- and post-COVID-19, using pooled data from all countries except Spain-Valencia. Shown is the *P*-value, categorised as below 0.01 (highlighted by a dark blue background), below 0.05 (highlighted by a bright blue background), and the exact value when not significant (i.e., no difference observed). The test was done independently for each combination of age group (rows) and hospitalisation type (column).

Age group	RTI	RSV-coded	RSV-confirmed
0-2mo	0.16	<0.05	0.12
3-5mo	0.19	<0.05	0.12
6-11mo	0.95	<0.01	0.44
1-2y	<0.05	<0.01	<0.05
3-4y	<0.05	<0.01	<0.05
5-17y	0.32	<0.01	<0.05

RSV, respiratory syncytial virus.

Discussion

These results from multi-country analyses demonstrate a continued substantial burden of RSV RTI hospitalisations in Europe, with a particularly high burden in the youngest age groups across all seasons and an increased burden in toddlers aged ≥1 year since the emergence of COVID-19. Morbidity and mortality are also high in young children, specifically in infants aged 0-2 months. The observed incidences pre-COVID-19 show variability between countries and seasons but in a range consistent with previously published studies in children <5 years in various countries (there are no published data on 5-17 years) [4,17–19]. The observed incidences from the active surveillance network (Spain-Valencia) were not systematically lower than the ones computed based on administrative data (all other countries), in opposite to previously published work [19].

This study shows that the LRTI diagnosis predominates in infants below 1 year old. For Scotland, where we do not have this granularity of age group, this is consistent with the <2 years old age group, which is clearly dominated by a bronchitis & bronchiolitis classification. Beyond this age range, the diagnosis distribution becomes more varied. Countries like Denmark, England, Finland, and The Netherlands see an important increase in pneumonia-related cases, whereas Scotland and England have a notable increase in URTI cases and unspecified LRTI. This is consistent with previously published work showing that RSV illness in toddlers and young children may have greater variability in clinical presentation and outcome [20]. Further studies are needed to evaluate the importance of the hospitalisation diagnosis to understand the RSV burden in toddlers and young children.

As RSV is not systematically tested in all countries except Spain-Valencia, assessing if one metric could enable us to have a good estimate or a good proxy is useful. We evaluated two different metrics: hospitalisation records with an RSV-related code, and hospitalisations with an associated RSV-positive laboratory test. We observed that, even in Spain-Valencia where testing was done for all included patients, not all patients with a positive RSV test were RSV-coded. These results highlight the persisting difficulties in estimating the RSV burden in the hospital setting, which gives inexact figures if we only monitor RSV burden with ICD coding or lab-confirmation. This likely leads to an underestimation of the RSV hospital burden, as was previously demonstrated, for example, leveraging modelling [5] or for adults [21]. Relying on registered diagnoses to approximate this hidden burden does not seem feasible currently, as we observed variations among diagnoses across seasons and countries. These results emphasise the need for more systematically testing, which would contribute to better monitoring of the RSV hospital burden. Harmonising coding practices would also facilitate European-level RSV monitoring, as if we observe similar trends between countries, we also observe differences, in terms of incidence rates for example (Figure 1). Setting aside Spain-Valencia where inclusion criteria and testing practice differed, these differences may come from national and hospital-based differences in terms of coding practices. Additional root causes are difficult to investigate as long as we do not quantify first these sources of variability in the data. In the absence of changes in coding practices, it could be interesting to investigate the impact of selected ICD codes further. Additional investigation could expand on prior work on LRTI [22] or on RSV [17]: (Canada, 2 years of data, children below 3 years old) or [23] (Germany, 5 years of data, primary care only); a subset of RSV codes, or the addition of non-RSV codes (e.g., some LRTI codes) could give a more stable proxy of RSV hospital burden.

The COVID-19 pandemic demonstrated a measurable impact: first, there was a reduction in RSV-related hospitalisations in 2020/2021. This reduced circulation of respiratory viruses has been previously described [7]. Second, an increased number of older children (>1 year) [18] were hospitalised compared to pre-COVID-19, whether measured by RSV-coded patients or RSV lab-confirmation. These results have previously been reported in other countries [7], although it is not clear if this is due to increased viral circulation, increased diagnostic testing, lower threshold for hospitalisation, or immunity debt. Limited evidence on the immunity debt hypothesis is available [24], yet it would explain some observations for England and Finland for 3-4 and 5-17 years. In a recent publication [25], the increase in observed RSV cases was attributed to the increase in RSV testing rather than changes in viral circulation or the immunity debt hypothesis. In Spain-Valencia, where testing was systematic, hospitalisation rates have not returned to pre-COVID-19 levels, but changes in hospital admission policies and procedures could explain this observation. Further evaluation of data from additional seasons is needed to better understand this post-COVID-19 increased hospitalisation trend. Further evaluation is also needed regarding the most severe cases of RSV, to gain a pan-European understanding beyond the specific countries' situations included in this study.

Conclusion

This study provides an updated overview of the RSV healthcare burden for all children from a European multi-country perspective. The significant RSV burden observed in all age groups and for all seasons—except the seasons with strong NPIs in place—underlines an unmet medical need for RSV in infants, toddlers, and young children. This study highlights that RSV-related hospitalisations remain an important problem even for toddlers beyond the first 6

months of age, for which there is currently no preventive or therapeutic measure available. The observed post-COVID-19 changes in the RSV hospitalisation burden among children over 1 year of age are making this affected population a priority for further studies, to better understand the root cause(s) of the burden increase and how it will evolve in coming seasons.

This study also highlights that limitations remain in capturing the true RSV hospital burden. This study provides evidence that the COVID-19 pandemic did not translate into significant additional testing or a change in coding at hospitals. Our data notably show that relying only on ICD coding does not capture the true burden of RSV hospitalisations, even post-COVID. Increased standardisation of coding practices – both within and across countries – along with increased testing would facilitate the identification of the true RSV burden at hospitals and, thereby, improve the quality of subsequent analyses, enabling to better inform public health decision-makers.

Declarations of competing interest

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Ethical approval statement

All data used for this study was not collected on purpose for this study, and all required authorisations were obtained before performing the data analysis – agreement numbers available upon request.

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Author contributions

OJ, AUF, CKJ, TL, DG, RAC, RK, AOS, TH, MVB, HN, ROY, and HC contributed to the design of the study. OJ, AUF, CKJ, TM, DG, RAC, and ROY contributed to the data extraction for this work. OJ and AUF contributed to the analysis of the data. OJ, KCD, and AUF contributed to the data visualization. OJ and KCD contributed to the manuscript writing, and all authors reviewed and validated this manuscript.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2025.107903.

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