Pneumonia and LRTI epidemiology in children under-5 years of age in South Africa: A Systematic Review and Meta-analysis, 1997-2024

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Studies on case fatality rates (CFR) for pneumonia in South African children under-5 reveal significant variability in case definitions and methodology. An overall CFR of 1.9% was reported for hospitalized children, 20.9% for those admitted to specialized care units, and 13.1% for HIV-infected children. A population-based study reported a CFR of 1.0% in under-5s. Despite this variability, national data indicate a steady decline in pneumonia CFR among the under-5s between 2012 and 2023 (4.1% to 1.5%). This is consistent with the present pooled CFR (1.9%) for hospitalized children in South Africa.

BACKGROUND

Pneumonia is a leading cause of hospitalization and mortality; with children, HIV-infected populations, and the elderly at greatest risk. The combined effects of climate change, COVID-19, and the emergence of antibiotic-resistant bacteria strains complicate pneumonia management. There is limited data describing the burden of lower respiratory tract infection (LRTI) and pneumonia in South Africa. This study aims to identify studies on CFRs from LRTIs and pneumonia among children under-5 years of age.

METHODS

We considered observational studies conducted in the South African population reporting pneumonia and LRTIs, using WHO definitions, ICD-10 and 11 codes, and Clinician's standard diagnosis. Relevant electronic databases, local libraries, and grey literature were searched from 1997 to 2024 to identify eligible studies.

At least two reviewers independently screened the results of the search for eligibility. Risk of bias assessment and data extraction were done independently by two authors. Discrepancies were resolved through discussion. Each included study was judged as 'low risk of bias', 'high risk of bias', or uncertain risk of bias, using BoDRevMan (a Burden of Disease Research Unit web-based assessment tool). STATA 18 software was used to pool studies, and a forest plot displayed the pooled estimates.

RESULTS

Eleven studies reporting on pneumonia and/or LRTIs in children under-5 years of age in South Africa were included in the review (Figure 1). There is a dearth of data on pneumonia assessment in South Africa. We included two reports of the same data source (DHIS). All studies assessed CFR due to pneumonia/LRTIs in children under-5 years of age in South Africa. Significant variability in pneumonia/LRTI case definition, study design and methodological heterogeneity between and within included studies were observed across included studies.

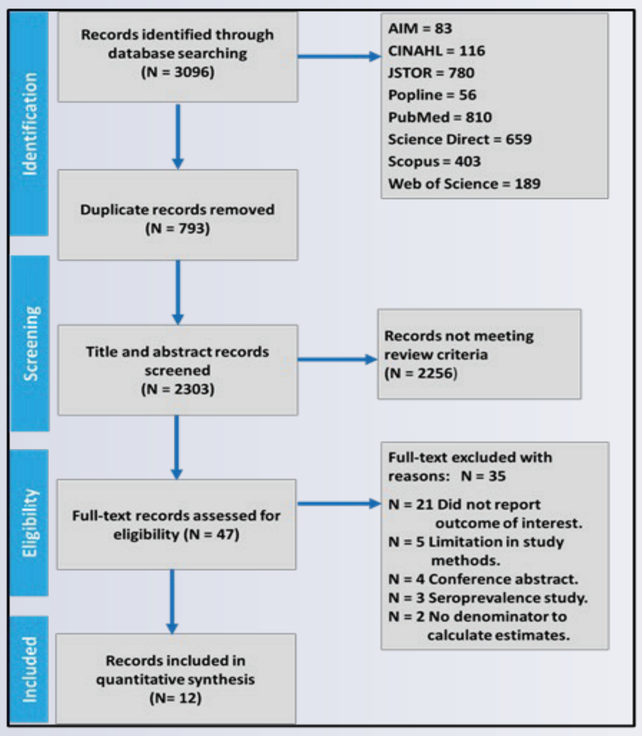

Figure 1. *Flow diagram of included studies.*

- Two national studies show a steady decline in the epidemiological trends of pneumonia CFR among children under-5 years of age in South Africa between 2011 and 2023 (Figure 2). The reason for the increase in pneumonia CFR in 2017/18 (2.4%) is unclear. It may be attributed to reduced hospital admissions in 2018[x]. The pneumonia CFR rose to 2.1% in 2020/21 from 1.6% the previous year, likely reflecting the impact of the COVID-19 pandemic.
- Eight studies reported pneumonia CFR among children hospitalized in public healthcare facilities. Two studies assessed CFR due to pneumonia in children admitted into specialized care units. A peri-urban community-sampled study described pneumonia-related CFR in children under-5 years of age, and one study reported CFR in HIV-infected children hospitalized for pneumonia (Figure 3).

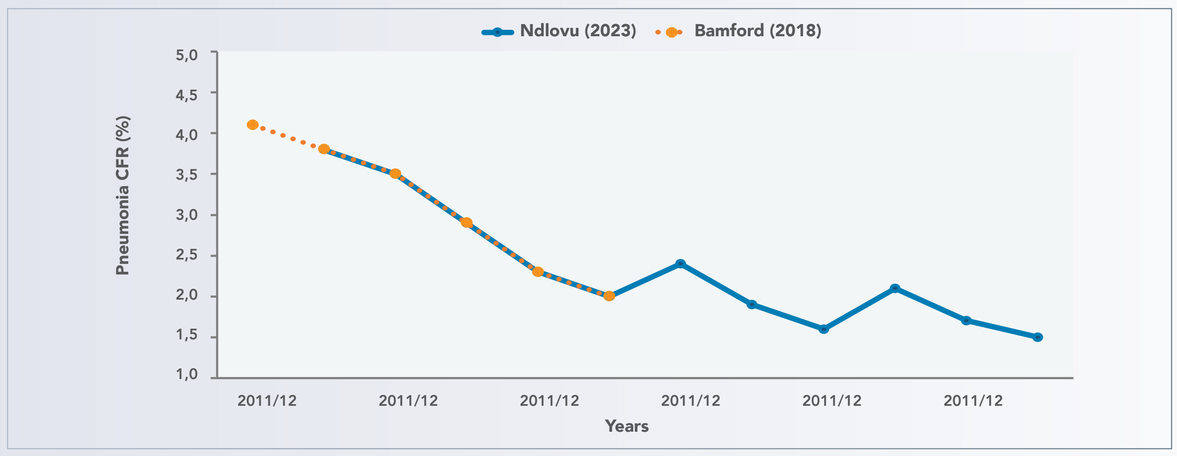

Figure 2. *National pneumonia CFR in hospitalized children under-5 years of age in South Africa 2011 – 2023.*
x District Health Barometer (DHB) 2017/18.

- In a subgroup analysis, the lowest pneumonia CFR (1.0%, 95%CI: -0.30% - 2.30%) was reported in a study. A pooled meta-analysis (8 studies) shows a 1.9% (95%CI: 1.46% - 2.32%) CFR for hospitalized children under-5 years of age. Pneumonia CFRs were 13.1% (95%CI: 10.2% –16.0%) and 25.0% (95%CI: 22.2%–27.9%) for children with HIV and those in intensive care units, respectively (Figure 3).
- Overall, the lowest estimate (1.0%) was found in one community-sampled study. The highest CFR was observed in specialized care units (25%). The pooled CFR of 1.9% for hospitalized children is consistent with the national pneumonia CFR (< 2.0%) among the under-5s in South Africa in 2023 (Figure 2).
- Given the substantial heterogeneity across studies, the appropriateness of a pooled meta-analysis may be questionable. However, meta-analysis can be valuable for estimating disease burden when suitable and standardized synthesis is used. Nonetheless, considering the heterogeneity, the pooled estimate should be interpreted with caution.

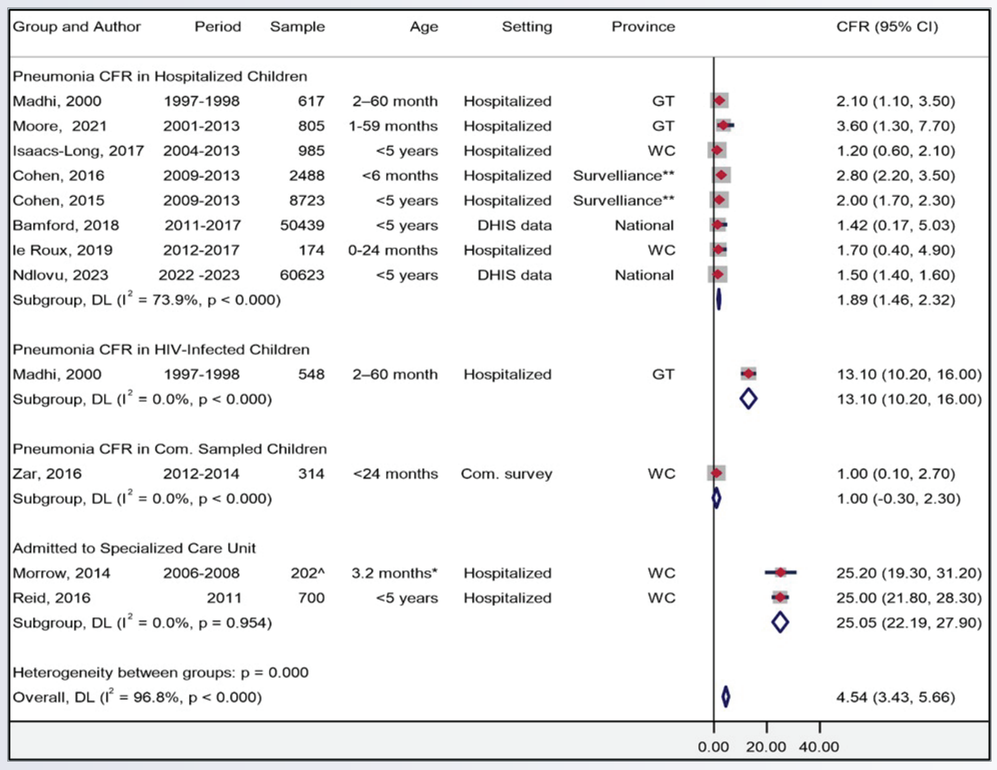

Figure 3. *Forest plot of pneumonia/LRTIs CFR in children under-5 years old in South Africa, 1997 – 2024.*
**= Median age of participants; ** Hospital-based surveillance. Included LRTI cases with RSV; ^ = study conducted in a referral hospital. HIV-infected estimate re-calculated [35+16=51] = 51/202. GT- Gauteng, WC-Western Cape.*

CONCLUSIONS

- Despite the potential influence of substantial heterogeneity on the pooled estimate, we provide evidence of a clear decline in pneumonia case fatality rate (CFR) among children under-5 years hospitalized for LRTI. This may reflect increased access to preventive and therapeutic interventions, such as antiretroviral drugs, vaccines, and improved case management. Nevertheless, additional reductions in pneumonia-related mortality are necessary.
- Efforts to reduce mortality from pneumonia/LRTI in children under-5 years of age need to be sustained. Exclusive breastfeeding for the first six months should be promoted together with public health education on the importance of vaccinations, hygiene practices, and avoiding the risks associated with smoking and environmental pollutants.

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