



Mortality and its risk factors in Malawian children admitted to hospital with clinical pneumonia, 2001–12: a retrospective observational study

Marzia Lazznerini, Nadine Seward, Norman Lufesi, Rosina Banda, Sophie Sinyeka, Gibson Masache, Bejoy Nambiar, Charles Makwenda, Anthony Costello, Eric D McCollum, Tim Colbourn



Summary

Background Few studies have reported long-term data on mortality rates for children admitted to hospital with pneumonia in Africa. We examined trends in case fatality rates for all-cause clinical pneumonia and its risk factors in Malawian children between 2001 and 2012.

Methods Individual patient data for children (<5 years) with clinical pneumonia who were admitted to hospitals participating in Malawi's Child Lung Health Programme between 2001 and 2012 were recorded prospectively on a standardised medical form. We analysed trends in pneumonia mortality and children's clinical characteristics, and we estimated the association of risk factors with case fatality for children younger than 2 months, 2–11 months of age, and 12–59 months of age using separate multivariable mixed effects logistic regression models.

Findings Between November, 2012, and May, 2013, we retrospectively collected all available hard copies of yellow forms from 40 of 41 participating hospitals. We examined 113 154 pneumonia cases, 104 932 (92.7%) of whom had mortality data and 6903 of whom died, and calculated an overall case fatality rate of 6.6% (95% CI 6.4–6.7). The case fatality rate significantly decreased between 2001 (15.2% [13.4–17.1]) and 2012 (4.5% [4.1–4.9]); $p_{\text{trend}} < 0.0001$. Univariable analyses indicated that the decrease in case fatality rate was consistent across most subgroups. In multivariable analyses, the risk factors significantly associated with increased odds of mortality were female sex, young age, very severe pneumonia, clinically suspected *Pneumocystis jirovecii* infection, moderate or severe underweight, severe acute malnutrition, disease duration of more than 21 days, and referral from a health centre. Increasing year between 2001 and 2012 and increasing age (in months) were associated with reduced odds of mortality. Fast breathing was associated with reduced odds of mortality in children 2–11 months of age. However, case fatality rate in 2012 remained high for children with very severe pneumonia (11.8%), severe undernutrition (15.4%), severe acute malnutrition (34.8%), and symptom duration of more than 21 days (9.0%).

Interpretation Pneumonia mortality and its risk factors have steadily improved in the past decade in Malawi; however, mortality remains high in specific subgroups. Improvements in hospital care may have reduced case fatality rates though a lack of sufficient data on quality of care indicators and the potential of socioeconomic and other improvements outside the hospital precludes adequate assessment of why case-fatality rates fell. Results from this study emphasise the importance of effective national systems for data collection. Further work combining this with data on trends in the incidence of pneumonia in the community are needed to estimate trends in the overall risk of mortality from pneumonia in children in Malawi.

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Introduction

Pneumonia is the leading cause of morbidity and mortality in post-neonatal children under 5 years of age.¹ According to the most recent estimates,¹ 0.9 million children died of pneumonia in 2013, and more than 95% of these deaths happened in low-income and middle-income countries.^{1,2}

Few data are available to show the epidemiology and public health burden of paediatric pneumonia cases in African hospitals. A recent systematic review³ identified only 11 studies reporting data on mortality from acute lower respiratory infections in hospitals within the

African region; these reports were unpublished, with very few exceptions,² and observation times were limited to 2–3 years.³

Malawi is currently one of the poorest countries in sub-Saharan Africa. However, according to national statistics,³ major progress was made in the past 15 years, and Malawi is on track to reach the Millennium Development Goal 4 of a two-thirds reduction in under-5 year mortality from 1990 to 2015.

In 2000, the Malawi Ministry of Health implemented a standardised medical chart for children younger than 5 years who were admitted to hospital with clinical

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Institute for Global Health, University College London, London, UK (N Seward PhD, B Nambiar MPH, Prof A Costello FMedSci, E D McCollum MD, T Colbourn PhD); WHO Collaborating Centre for Maternal and Child Health, Institute for Maternal and Child Health IRCCS Burlo Garofolo, Trieste, Italy (M Lazznerini PhD); Acute Respiratory Infection Control Programme, Community Health Sciences Unit, Lilongwe, Malawi (N Lufesi MPH); Parent and Child Health Initiative (PACHI), Lilongwe, Malawi (R Banda BScNE, S Sinyeka MSc, G Masache MSc, C Makwenda MSc); and Johns Hopkins School of Medicine, Department of Pediatrics, Division of Pulmonology, Baltimore, MD, USA (E D McCollum)

Correspondence to: Dr Tim Colbourn, Institute for Global Health, University College London, London WC1N 1EH, UK t.colbourn@ucl.ac.uk

or
Dr M Lazznerini, WHO Collaborating Centre for Maternal and Child Health, Institute for Maternal and Child Health IRCCS Burlo Garofolo, 34137, Trieste, Italy marzia.lazznerini@burlo.trieste.it

Research in context

Evidence before this study

A recent systematic review identified only 11 studies reporting data on mortality in children admitted to hospital with acute lower respiratory infections in the African region, and with very few exceptions, reports were unpublished, and with an observation time limited to 2–3 years. We also searched PubMed using the following search strategy: (“Pneumonia”[Mesh] OR “Respiratory Tract Infections”[Mesh]) AND (“Child”[Mesh] OR (“child”[MeSH Terms] OR “child”[All Fields] OR “children”[All Fields]) OR (“pediatrics”[MeSH Terms] OR “pediatrics”[All Fields] OR “paediatric”[All Fields]) OR (“pediatrics”[MeSH Terms] OR “pediatrics”[All Fields] OR “pediatric”[All Fields])) AND (“Malawi”[MeSH Terms] OR “Malawi”[All Fields]) from inception to July 8, 2015, with no language restrictions. We found 68 studies, none of which covered the range of years and numbers of hospitals of our study.

Added value of this study

We have analysed an individual patient database of hospitalised cases of pneumonia in children in Malawi, collected over a 12 year period. The data shows a clear decline in case fatality rate between 2001 and 2012, although this rate remains high in some subgroups (children with very severe pneumonia, severe undernutrition, severe acute malnutrition, and symptom duration >21 days).

Implications of all the available evidence

Overall, our study supports the finding from the Millennium Development Goal 4 indicators that under-5 mortality has significantly decreased in Malawi in recent years. Further research is needed to link hospital data with community-based pneumonia data and to investigate quality of care provided to children at different levels of the health system.

Panel: Classification of severity of clinical pneumonia¹⁰

Non-severe pneumonia (2–59 months of age)*

- Cough, difficulty breathing, or both
- Fast breathing for age†
- No lower chest indrawing and no danger signs‡

Severe pneumonia (<2 months of age)

- Cough, difficulty breathing, or both, and
- Lower chest indrawing or fast breathing for age*†
- No danger signs‡

Severe pneumonia (2–59 months of age)

- Cough, difficulty breathing, or both
- Lower chest indrawing
- No danger signs‡
- Might or might not have fast breathing for age†

Very severe pneumonia (0–59 months of age)

- Cough, difficulty breathing, or both
- At least one danger sign‡
- Might or might not have fast breathing for age†
- Lower chest indrawing

*Young infants younger than 2 months do not have a non-severe pneumonia classification. †60 breaths per min or more if child is younger than 2 months; 50 breaths per min or more if child is 2–11 months old; 40 breaths per min or more if child is 12–59 months old. ‡Danger signs are any of the following: central cyanosis, severe respiratory distress (grunting, head nodding, severe chest indrawing), stridor, a general danger sign (inability to drink, breastfeed, or both, lethargy or unconsciousness, convulsions), apnoea (if child is 0–2 months of age). Wheeze is not considered in diagnosis or classification of severity of pneumonia.¹⁰

See Online for appendix

pneumonia. These data have been routinely collected prospectively but never comprehensively analysed. We have analysed the available individual patient data from hospitals in Malawi that implemented this routine system of data collection between 2001 and 2012, with the objective of describing trends in case fatality rates for all-cause clinical pneumonia and its risk factors in children younger than 5 years.

Methods

Study design and participants

In 2000, the Malawi Ministry of Health's Acute Respiratory Infection unit (ARI) and the International Union Against Tuberculosis and Lung Disease implemented the Child Lung Health Programme (CLHP),^{6,7} which included two key elements: national clinical pneumonia management guidelines⁸ adapted from WHO guidelines;^{9,10} and the implementation of a standardised patient chart (the yellow form) to be used as an official medical file for each child admitted to hospital for pneumonia. CLHP clinical pneumonia was defined according to Malawi ARI guidelines (panel). The yellow form contains individual patient data such as demographic variables, clinical signs and symptoms, pneumonia disease severity, comorbidities, treatments received, and outcomes (appendix pp 3–4). The following criteria were used for CLHP programme participation: an active ARI programme; leadership commitment; one health worker responsible for implementation (local ARI coordinator); and about 100 000 population catchment area.⁶ District government hospitals were prioritised for participation in CLHP, and by 2004, 22 of 23 district hospitals and three of four central government hospitals were enrolled.⁶ In 2005, with the support of the Scottish Government, the programme expanded to include the Christian Hospital Association of Malawi hospitals, which are mostly first-level, fee-based facilities. By 2012, 22 of 23 district hospitals, three of four central hospitals, and 16 of 37 Christian Hospital Association of Malawi facilities were participating in the CLHP (appendix p 5).

From 2001 to 2005, major external support was provided to the CLHP: health staff were trained in the programme, which included a follow-up refresher session and on-the-job training; international expert technical guidance that focused on maintaining data quality, accuracy, and completeness was provided twice annually; and

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