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Abstract

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Background

Pneumonia, the leading cause of child mortality, was responsible for approximately 1.4 million deaths among children < 5 years of age in 2010 [1]. Pneumonia is also a major cause of global morbidity with an estimated 156 million episodes and 14.9 million hospitalizations per year [2,3]. The incidence of pneumonia illness and deaths is marked by a substantial wealth gap, with the majority of morbidity and mortality occurring in developing countries and among the poorest children [4].

Studies suggest that optimal breastfeeding practices, including exclusive breastfeeding during the first six months of life and continued breastfeeding until 24 months of age, are critical for reducing the burden of pneumonia among infants and young children [4-6]. The protective effect of human milk against respiratory infection is attributed to its numerous immunobiological components [7-9].

A systematic review published in 2002, which assessed the optimal duration of breastfeeding for reduction of respiratory illness and mortality, provided support for the global recommendation for exclusive breastfeeding during the first 6 months of life [6]. The objective of this systematic review is to assess and consolidate evidence supporting the protective effects of breastfeeding on pneumonia incidence, prevalence, hospitalizations and mortality among children <24 months of age in developing countries. To achieve this aim, we employed carefully developed and standardized methods of comprehensive systematic review and meta-analysis [10,11]. The results of this review will be utilized to generate Lives Saved Tool (LiST) projections of the potential deaths averted by

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increasing the coverage of exclusive breastfeeding for the first 6 months of life and continued breastfeeding until 24 months of age [11].

Methods

We conducted a systematic literature review of studies

measure [15]. In brief, the scoring system penalizes a study for failure to incorporate the following methods intended to reduce bias: (1) exclusion of events among neonates < 7 days of age; (2) exclusion of non-singleton births, premature births, low birth weight infants, and infants with congenital abnormalities or other serious illnesses; (3) determination of breastfeeding exposure immediately before event onset, rather than that concurrent with outcome; (4) determination of the association between weaning and illness/poor growth and subsequent exclusion of such infants or young children [17]. See additional file 1 for detailed abstraction information about studies.

Results

Our review identified 1164 unique publications. After title and abstract review we fully screened 155 papers

among predominantly (RR: 1.98; 95% CI: 1.25-3.12), partially (RR: 1.88; 95% CI: 1.16-3.04) and not (RR: 6.03; 95% CI: 3.18-11.44) breastfed infants 0-5 months of age compared to those exclusively breastfed (Table 2).

Based on the CHERG grading system, all outcomes were moderate in study design and quality (Table 4). There was a consistent trend towards protection conferred by breastfeeding across all outcome-specific estimates. Based on the CHERG standard rules, there is sufficient evidence of the protective effect of exclusive breastfeeding on mortality among infants 0-5 months of age to support its inclusion in *LiST;* the estimates comparing predominant, partial, and no breastfeeding exposure to exclusive breastfeeding on pneumonia mortality will be included in the *LiST* model (Table 5). The final effect size for pneumonia mortality among infants and young children 6-23 months of age was derived from studies with fewer than 50 total events per outcome (Table 5). Thus, according to CHERG

standard rule 0, there is inadequate evidence to support the inclusion of these effect sizes in *LiST.*

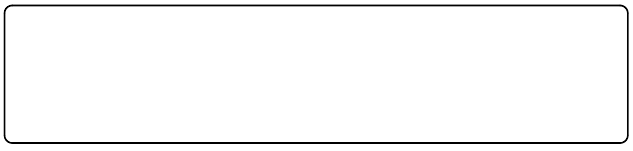
Discussion

Our findings highlight the protective effects of breastfeeding against pneumonia incidence, prevalence, hospitalizations, mortality and all-cause hospitalizations and mortality. Exclusive breastfeeding conferred incrementally greater protection among infants 0-5 months of age than predominant and partial breastfeeding (Table 2). Furthermore, continued breastfeeding through 23 months of age was protective compared to no breastfeeding (Table 3). These results support the WHO recommendation for

outcomes and age groups and it is therefore improbable that such bias is completely accountable for our findings. This assertion is supported by repeat analyses conducted by four included studies, which report effect sizes of the same direction and comparable magnitude before and after adjusting for reverse causality [20-22,25]. Furthermore, findings were consistent over a wide geographic area.

Our analyses were limited by the inclusion of effect measures calculated with raw data, unadjusted for potential confounders of breastfeeding and illness, such as socioeconomic status. In addition, included studies were observational and thus confounding may be present. Nevertheless, this methodology has been utilized in previous studies and was not a major limitation to our analyses given the consistency across included studies with and without adjustment for i(hereng)5s with 6(hereng)5s

in a conservative estimate of the protection conferred by breastfeeding exposure [28].



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