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## A review on effect of anaemia on the severity of acute bronchiolitis

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### **Abstract**

Even though anaemia increases the risk of lower respiratory tract infections, there are only limited data regarding the connection between anaemia and acute bronchiolitis. This study aims to determine whether anaemia increases the severity of infants' acute bronchiolitis as a particular clinical condition.

**Keywords:** Acute bronchiolitis, anaemia, infants, respiratory tract infections

### **Introduction**

Acute bronchiolitis is a viral disease predominantly located in the lower respiratory tract that usually affects infants six months and older and toddlers<sup>1</sup>. A respiratory syncytial virus is a risk factor for severe bronchiolitis. Risk factors can be categorised as environmental, maternal and host factors. Ecological factors include mothers' exposure to allergens, cigarette smoke, overcrowding and particulate matter. Host-related factors are male sex, prematurity, and low birth weight. Other risk factors include lack of breastfeeding, maternal age, incomplete vaccination, and family history of asthma<sup>2</sup>.

Anaemia is a severe public health problem that impacts mental and physical development, health maintenance and work performance. WHO estimates the worldwide prevalence of anaemia to be 1.62 billion, of which the highest prevalence of anaemia (47.4%) is common among preschool-aged children<sup>3</sup>. Iron is essential for the development and growth of children and is also responsible for the etiopathogenic mechanisms of various pathologies. Lower respiratory tract infections appear to be directly related to insufficient or inefficient use of iron, and there is an altered immune response. The previous report indicated that anaemia is a significant risk factor for lower RTI in Children, with an odds ratio of 3.59. Infants will reduce the risk significantly in those who were exclusively breast fed<sup>4</sup>.

A full-term new-born infant contains about 0.5 g of iron compared to 5 g of iron in adults. It is necessary to absorb approximately 1mg of iron daily to maintain a positive iron balance in childhood. Because less than 10% of dietary iron is usually absorbed, a dietary intake of 8-10 mg daily is necessary to maintain iron levels. Breastfed infants have an advantage because they absorb iron 2-3 times more effectively than infants fed cow's milk. It is well established that infection causes anaemia, and several mechanisms are to explain the basis of anaemia in infections. Despite the relationship known, the association of RTI with anaemia in various societies are needed for the timely management of infection as well as to provide the necessary awareness about the importance of a balanced diet<sup>5</sup>.

Anaemia increases the risk of lower respiratory tract infection in children, yet there is not enough evidence showing anaemia's effect on acute bronchiolitis<sup>6</sup>. This systematic review focuses on whether decreased haemoglobin levels increase children's risk of acute bronchiolitis.

### **Literature search strategy and selection criteria**

An extensive literature search was conducted to identify relevant published articles evaluating COPD and anaemia as a single associated comorbidity. The electronic databases explored included: PubMed, CINAHL plus, MEDLINE (CSA), AMED, and the Cochrane library, with the following words in different combinations; bronchiolitis, anaemia, infants, children, severe, haemoglobin, epidemiology, pathophysiology, guidelines, treatment,

management. A supplementary hand search of bibliographic references of extracted articles and existing reviews was also conducted to identify potential studies not ascertained in the electronic database searches. Each abstract was independently evaluated by the same research member, who then retrieved the full text. This procedure was followed by a second reviewer for independent confirmation. An article was considered relevant for full text retrieval if it met the following inclusion criteria: • Studies that explored the relationship between bronchiolitis and anaemia, in either community • Studies that reported the prevalence of anaemia • Age group from 2 months to 1 year • Randomized

or nonrandomized study design; either prospective or retrospective.

### Study characteristics

Based on the keyword/search phrases and the manual search of bibliographic references, a total of 110 article titles were determined to be potentially relevant. 98 of them were deemed to be potentially appropriate. 86 were cut after the initial screening. Only 8 of the 12 full-text papers that were deemed suitable for this analysis (Fig. 1) fully met the inclusion criteria.

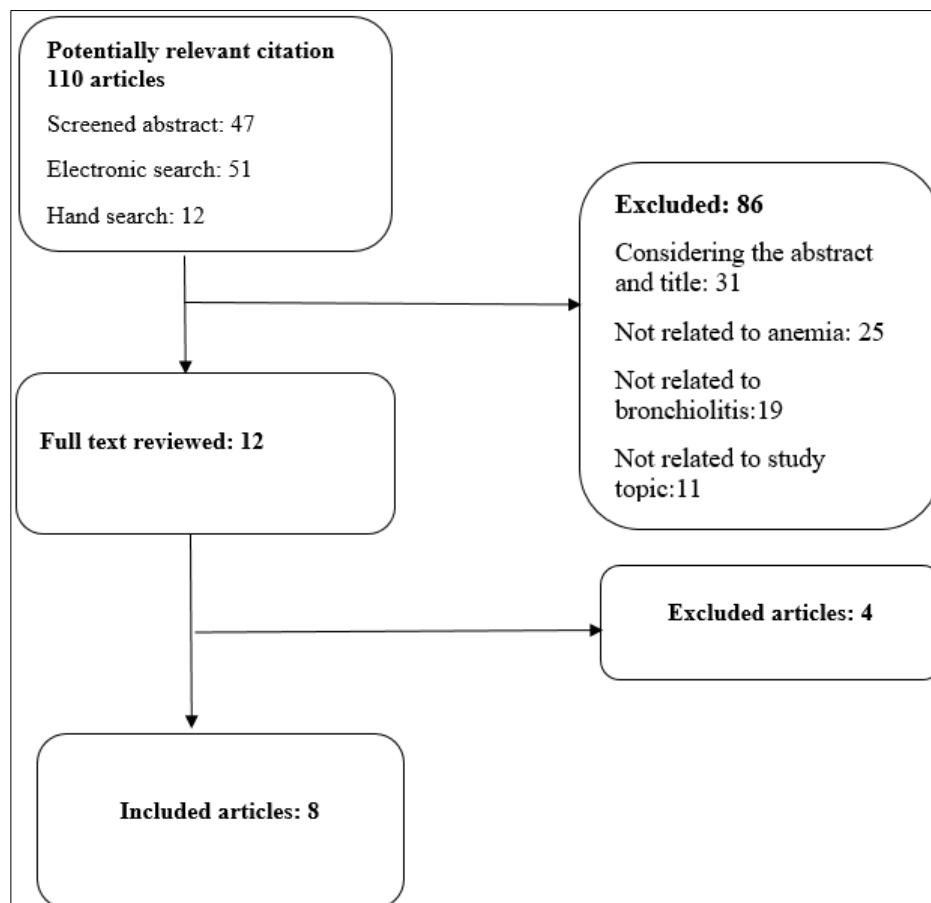


Fig 1: (Flowchart of literature search)

### Prevalence of bronchiolitis in anaemia

Bronchiolitis is the most common lower respiratory tract infection in children under 2 years. Around 3% of all infants younger than one year are admitted with bronchiolitis. According to WHO, 1.62 billion people around the world have anaemia, with preschool-aged children having the highest prevalence (47.4%). As recommended by WHO antenatal iron supplementation delays the neonatal presentation of anaemia and thus it is commonly presented after 6 months of age [7].

Haemoglobin (Hb) level is the most reliable indicator of anaemia among all individuals. Anaemia is a severe public health issue that can affect anyone at any stage of life. However, it is more common among small children and pregnant women who are iron deficient. In India, anaemia affects over 75% of children between the ages of 1-3, putting them at risk for several complications, including infections. All infections of the lungs and airways below the larynx are referred to as lower respiratory tract infections

(LRTI), including pneumonia, croup syndromes, bronchitis, and bronchiolitis. Zaki *et al.*, claimed that in the past few years in Pakistan, hospitalisation rates for infants have increased from 0.9% to 4% because of acute bronchiolitis [8]. During the last few years, hospitalisation rates have increased among US children from 1% to 3% due to acute bronchiolitis, which reflects significant morbidity [9]. A study by Sheikh *et al.*, proved that anaemia is significantly found in patients with lower respiratory tract infection, and these patients were 4.5 times susceptible to anemia [10].

### Summary of bronchiolitis

Bronchiolitis is associated with later wheezing and asthma in children and adults. It has been discovered that treating acute bronchiolitis with bronchodilators is ineffective; supportive care, such as oxygen supplementation and ventilatory support, may be necessary. Figure 2 is intended to serve as a guideline for stratifying bronchiolitis severity under Standard Treatment Guidelines 2022 [11].

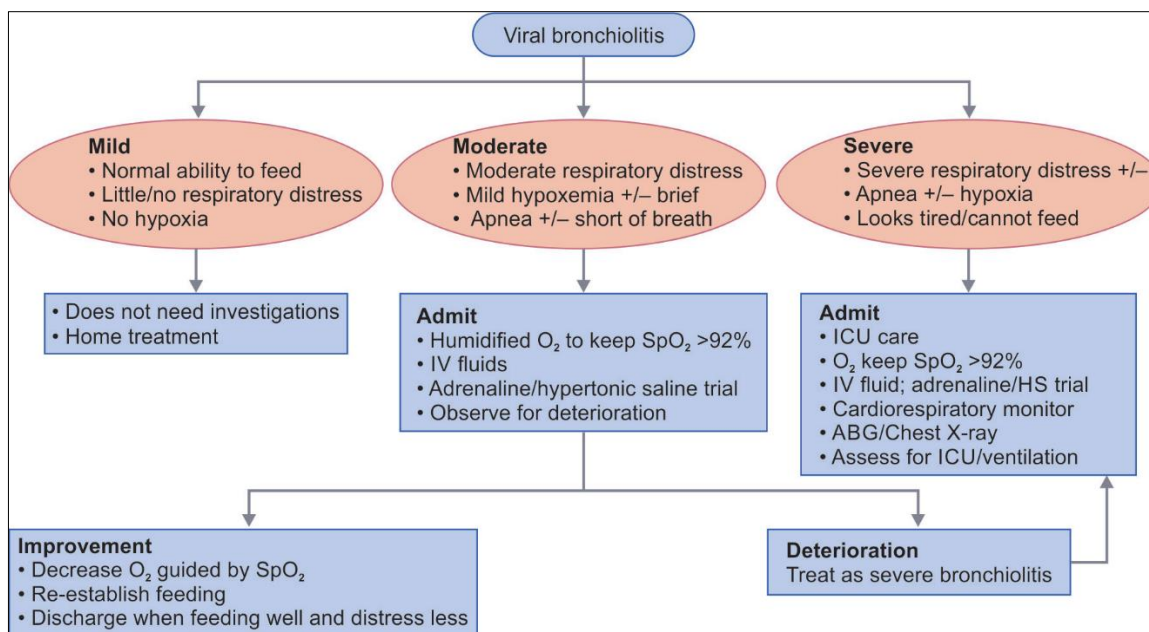


Fig 2: (Summary of bronchiolitis)

(ABG: arterial blood gas; ICU: intensive care unit; IV: intravenous; SpO2: oxygen saturation)

**Outcome**

The most widespread condition that harms human health, socioeconomic advancement, and the general improvement of humanity is anaemia. Nutritional deficiencies, particularly iron deficiency, are the most frequent cause of anaemia. For the growth and maturation of immunity, and subsequently, the development of resistance against illnesses, a balanced and adequate nutritional supplementation to growing children is of the most significant importance. Inadequate nutrition, including an iron deficit, is an indirect risk factor for lower respiratory tract infections.

Many studies have observed an association between anaemia and the risk of developing bronchiolitis in paediatric patients. We found a significant negative correlation between the Hb level and the severity of bronchiolitis. The most affected age group was 3 months to 23 months, which is quite comparable with the study by Malla T *et al.*, The common involvement of this age group could be because supplementary and complementary feeding practices that might be inadequate and inappropriate are practised and advocated widely in this age, due to which Hb could touch the nadir [12]. Zaki *et al.*, claim that if

patients have a haemoglobin level less than or equal to 10 grams/dL, they are more likely to get severe acute bronchiolitis (about 10 times), and these are the patients that remain admitted in the hospital for a longer period [8]. Hussain *et al.*, showed that from a group of 220 patients ranging from 1 month to 5 years, anaemic patients were 4.6 times more likely to get lower respiratory tract infection [10]. According to Mourad *et al.*, patients with haemoglobin levels <11grams/dL are twice as likely to get lower respiratory tract infection than the healthy control group. Moreover, on account of Ramakrishnan *et al.*, the prevalence of anaemia was 33%, indicating that haemoglobin is a high risk for bronchiolitis. A recent study by Elif *et al.*, in Turkey, reported that anaemia may influence the clinical expression of acute viral bronchiolitis in infants. A retrospective study by Thomas *et al.*, proved that the mean haemoglobin level was 9.24g/dl and found that anaemic children were 2.68 times susceptible to lower respiratory tract infection. (Table 2) This study suggested that the coexistence of anaemia may worsen the clinical expression of bronchiolitis in infants. Therefore, bronchiolitis in children under two years may occur less frequently and be less severe if anaemia is identified and treated. As a result, it is hypothesised that the haemoglobin level may be a separate risk factor for the clinical severity of bronchiolitis in new-borns.

Table 2: (Studies that met the inclusion criteria of bronchiolitis patients with anaemia)

S. No	Author	Year	Country	Study design	Sample size of bronchiolitis patients	Anaemia prevalence no. (%)
1.	Mourad <i>et al.</i>	2022	Pakistan	Case control study	160	30 (48%)
2.	Elif <i>et al.</i>	2021	Turkey	Retrospective study	163	43 (26.3%)
3.	Manisha <i>et al.</i>	2020	India	Prospective study	90	27 (24.3%)
4.	Thomas <i>et al.</i>	2019	India	Retrospective study	50	14 (28%)
5.	Hussain <i>et al.</i>	2014	India	Prospective Case control study	220	71 (64.5%)
6.	Malla <i>et al.</i>	2010	Nepal	Prospective study	150	30 (21.42%)
7.	Mourad <i>et al.</i>	2010	Lebanese	Prospective comparative study	200	16 (32%)
8.	Ramakrishna <i>et al.</i>	2006	India	Prospective study	100	33 (33%)

**Conclusion:** Overall, it can be inferred from this review that anaemia can worsen bronchiolitis. The prevalence and

severity of bronchiolitis may be reduced with the early and precise diagnosis and treatment of anaemia in infants.

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