Does anaemia increase the risk of acute lower respiratory tract infections in children aged 1-5 years?

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Abstract

Introduction*:* Anaemia is a major problem in children aged 1-5 years. Lower respiratory tract infection (LRTI) is defined as inflammation of the respiratory tract below the level of the larynx and is a common cause of admission to paediatric units in Sri Lanka. It is reported that anaemic children have a high risk of developing LRTIs.

Objectives: To identify the association between anaemia and increased risk of developing LRTI in children aged 1-5 years presenting to a selected children's hospital in Sri Lanka.

Method: A case-control study was conducted in all paediatric medical wards and intensive care units in Sirimavo Bandaranayake Children's Hospital, Peradeniya, from November 2022 to March 2023. Children aged 1-5 years admitted with LRTI were selected as cases. Children aged 1-5 years admitted without features of respiratory tract infection were selected as controls to match the age and sex of the cases. Data were collected from a questionnaire to parents and also from patient records. Data were analysed using SPSS version 22.

Results: A total of 272 children was included in the study. Anaemia was found in 56.6% of cases and 44.9% of controls. The mean haemoglobin (Hb) levels of the cases and controls were 10.00±0.899 and 10.16±0.8032 respectively. Among cases, there were 57.4% of hypochromic-microcytic peripheral smears. Frequency of anaemia was significantly higher among cases as compared to controls (Odds ratio 1.605; CI: 1.025- 2.590, p-value= 0.045).

Conclusions: The frequency of anaemia was significantly higher among cases as compared to controls. Anaemic children were 1.6 times more prone to get LRTI.

(Key words: Acute lower respiratory tract infection, Anaemia, Hypochromic microcytic)

Introduction

Anaemia is defined as a haemoglobin (Hb) or haematocrit level lower than the age-adjusted reference range for healthy children[1]. Although there are some initial changes, after the age of 6 months, Hb level in children remains more than 11g/dL[1]. Hb levels below 11g/dL are considered as anaemia[1]. Anaemia is more common in children 0-5 years old. According to available data, global prevalence of anaemia in children is 39.8%[2].

Lower respiratory tract infection (LRTI) is defined as inflammation of the respiratory tract below the level of the larynx[3] and is a common cause of admission to paediatric units in Sri Lanka as well as worldwide[4]. Multiple factors like low birth weight, poor socio-economic status and poor nutrition have been identified as risk factors for LRTI[5]. When there is anaemia, the oxygen-carrying capacity is reduced and this affects the metabolic demand of the body and will affect almost all systems in the body including the immune system. As a result, there is evidence to suggest that it increases the risk of infections including LRTIs[6].

In Sri Lanka, LRTIs are the leading cause of childhood mortality and morbidity[7]. According to available data, LRTIs are responsible for 9% of deaths of Sri Lankan children under 5 years of age[8]. According to the National Nutrition and Micro-nutrient Survey 2012, prevalence of childhood anaemia in Sri Lanka is 15.1%[8]. Hence identifying anaemia and strengthening already implemented preventive measures will be an important strategy to control LRTI in children less than 5 years old. As this association has not been assessed or published previously in the Sri Lankan setting, we designed this case-control study to identify the association of anaemia and LRTI in a selected group of Sri Lankan children admitted to a tertiary care children's hospital.

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Objectives
To identify the association between anaemia and increased risk of developing LRTIs in children aged 1- 5 years presenting to all paediatric medical wards and ICUs in the Sirimavo Bandaranayake Children's Hospital (SBSCH), Peradeniya.

Method
A case-control study was conducted from November 2022 to March 2023. Cases were children aged 1-5 years admitted to SBSCH Peradeniya with LRTI. Children aged 1-5 years admitted to SBSCH Peradeniya without any features of respiratory tract infection were selected as controls to match the age and sex of the cases.

Inclusion criteria for cases: Children aged 1-5 years with a diagnosis of LRTI with symptoms of fever, tachypnoea, cough, chest retractions and rhonchi or crepitations as per WHO criteria, admitted during study period. Chest x-ray was taken depending on clinical judgement.

Inclusion criteria for controls: Children aged 1-5 years presenting without respiratory manifestations to paediatric wards during study period.

Exclusion criteria for cases and controls: Children with prematurity, congenital chest wall deformities, systemic or chronic diseases, pulmonary tuberculosis, cerebral palsy, malnutrition, exposure to frequent pollutants/smoke and immunodeficiency.

Convenience sampling of all cases of LRTI was done after checking exclusion criteria as cases. Age and sex-matched controls who fulfilled inclusion criteria were selected as controls.

This was done following history taking and examination. Investigations included haemoglobin and peripheral smears in all patients. Patient data were collected from the patient records and parents when relevant using a questionnaire. There were 136 cases and 136 controls in this study.

Ethical issues: Approval for the study was obtained from the Ethics Review Committee of the Sri Lanka College of Paediatricians (No. SLCP/ERC/2022/36). Administrative permission to conduct the study was taken from SBSCH director and relevant consultants. Relevant data related to children were collected from parents after written informed consent. All data collected were kept confidential and available only to investigators.

Statistical analysis: Data were processed using SPSS 22.0 software.

Results
The total number of participants was 272 comprising 136 cases and 136 controls. Table 1 shows the socio-demographic characteristics and association between independent factors.

Table 1: ***Socio-demographic characteristics and association between independent factors (n=272)***

Socio-demographic characteristic	Cases *(n=136)* n (%)	Controls *(n=136)* n (%)	Significance
Age group (months)			
13-24	30 (22.1)	34 (25.0)	
25-36	49 (36.0)	45 (33.1)	X^2=0.456, df=4, p= 0.928
37-48	23 (16.9)	24 (17.6)	
49-60	34 (25.0)	33 (24.3)	
Gender			X^2=0.727, df=1, p=0.394,
Male	78 (57.4)	71 (52,2)	Odds ratio 1.231 (CI 0.763-
Female	58 (42,6)	65 (47.8)	1.986)
Haemoglobin status			X^2 =3.786, df=1, **p= 0.045**
Anaemia	77 (56.6)	61 (44.9)	Odds ratio 1.605
No anaemia	59 (43.4)	75 (55.1)	(CI 1.025- 2.590)
Oxygen supplementation after admission	53 (39.0)	21 (15.4)	X^2 =19.010, df=1, **p= 0.000**
Yes	83 (61.0)	115 (84.6)	Odds ratio 3.497
No			(CI 1.960- 6.238)
Educational level			X^2 =14.045, df=1, **p= 0.000**
Up to Ordinary Level (O/L)	106 (77.9)	77 (56.6)	Odds ratio 2.707
Advanced level (A/L) and above	30 (22.1)	59 (43,4)	(CI 1.596- 4.593)
Past history of LRTI			X^2 =0.433, df=1, p= 0.510
Yes	39 (28.7)	44 (32,4)	Odds ratio 0.847
No	97 (71,3)	92 (67.6)	(CI 0.501- 1.410)
Peripheral smear			X^2 =5.309, df=1, **p= 0.021**
Hypochromic microcytic	78 (57,4)	59 (43.4)	Odds ratio 1.755
Normochromic normocytic	58 (42,6)	77 (56,6)	(CI 1.086 - 2.837)

The age range of the participants was 13 months to 60 months. Mean age of the cases was 37.21±13.341 months and the mean age of the controls was 37.06 ±13.461 months. Haemoglobin (Hb) range among the cases was 8.40-12.20g/dL and among the controls, it was 8.60-12.0g/dL. The mean Hb levels of the cases and controls were 10.00±0.899g/dL and 10.16±0.8032g/dL respectively. The frequency of anaemia was significantly higher among cases as compared to controls (Odds ratio 1.605; CI: 1.025-2.590, p-value= 0.045) as shown in Table 1.

The risk for anaemia among the cases, in the age group 13-24 months was 1.250 times more as compared to controls. The risk of anaemia was 1.255 times more for cases in the age group 25-36 months old. Risk of anaemia among cases who were in the age group 37-48 months and 49-60 months old was 2.593 and 2.00 times more as compared to controls (Table 2).

Table 2: ***Frequency of anaemia (cases and controls) stratified for age***

Age	Anaemia	Cases n (%)	Controls n (%)	Odds Ratio	p-value
13 - 24 months	Yes No	14 (46.7) 16 (53.3)	14 (41.2) 20 (58.8)	1.250 (CI 0.464 - 3.365)	0.659
25 - 36 months	Yes No	32 (65.3) 17 (34.7)	27 (60.0) 18 (40.0)	1.255 (CI 0.543 - 2.900)	0.595
37 - 48 months	Yes No	14 (60.9) 09 (39.1)	09 (37.5) 15 (62.5)	2.593 (CI 0.799 - 8.408)	0.109
49 - 60 months	Yes No	17 (50.0) 17 (50.0)	11 (33.3) 22 (66.7)	2.000 (CI 0.745 - 5.371)	0.167

The educational levels of parents of cases and controls are shown in Figure 1. Among the cases 16.2% of parents were uneducated, 26.5% were educated up to grade five, 35.3% up to GCE ordinary level and 19.9% up to GCE advanced level; 2.2% graduated among parents in the cases group. Among the controls 5.1% parents were uneducated, 14% were educated up to grade five, 37.5% up to GCE ordinary level and 33.8% up to GCE advanced level; 9.6% graduated among parents in the control group.

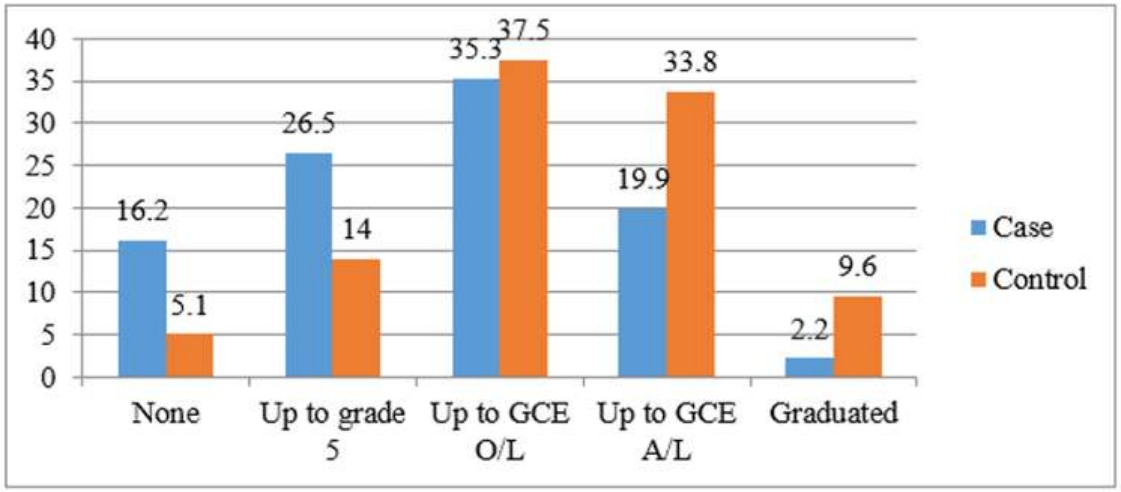

Figure 1: Educational levels of parents of cases and controls

Discussion

In Sri Lanka, LRTI is the leading cause of childhood mortality and morbidity[7]. Anaemia is a major nutritional problem in children below 5 years of age[8]. In our study the mean age of anaemic children was 37.2 months (3.1years). In a Pakistani study[9], the mean age of anaemic children was 2.5 years and in an Egyptian study[10], the mean age of anaemic children was 2.3 years. In our study, among the cases, 42.8% were in the 2-3-year age group but, in the controls, the commonest age group (29.1%) was the 4-5-year age group. In one study most anaemic patients were in the 1.3-2.5-year age group in cases[9].

In our study, there was no significant difference

between genders. Ahmad T, *et al*[9] has also reported that there was no significant difference between genders. These findings are comparable with a study conducted in Mumbai[11]. This was also compatible with the findings of Mourad S, *et al*[12].

The mean Hb level of the cases was 10.0g/dL and in controls, it was 10.16g/dL. In an Indian study, this was 9.99g/dL and 11.85g/dL in cases and controls respectively[11]. Another study showed mean Hb was 10.83g/dL in cases and 11.70g/dL in controls[9]. Among cases 77 (56.6%) were anaemic whilst in the control group 61 (44.9%) children were anaemic. Frequency of anaemia was significantly higher among cases as compared to controls (Odds ratio 1.605; CI: 1.025-2.590, p-value= 0.045). Hence, anaemic children were found to be 1.60 times more susceptible to LRTI in the 1-5-year age group. A study by Ramakrishnan K, *et al*[6] has reported that 74% of cases and 33% of controls were anaemic. A Lebanese study[12] study showed that 32% of cases and 16% of controls had anaemia. A Nepali study[13] showed OR of 2.681 illustrating 2.681 more likelihood of developing LRTI in children with anaemia. In a Pakistani study[9] there was an OR of 4.162 and an OR of 2.08 in Mourad et al study[12]. As depicted by our study and other similar studies anaemia was significantly found in LRTI patients. Thus, prevention and early diagnosis of anaemia can significantly reduce the incidence of LRTI.

In 77.9% instances parents of cases were educated up to O/Ls and 22.1% were educated above O/Ls. This may play a role in decreasing the incidence of anaemia since the educational level will improve the children's food practices, which in turn will reduce the incidence of LRTI.

Among cases, there were 78 (57.4%) hypochromic-microcytic peripheral smears and 58 (42.6%) normochromic normocytic smears. There were 59 (43.4%) hypochromic-microcytic smears and 77 (56.6%) normochromic normocytic smears in the control group. In one study they have analysed blood smears. In cases there were 78.4% hypochromic-microcytic peripheral smears and 21.6% normochromic normocytic smears[11]. In another study there was no significant association in the smear[13].

Conclusions

The frequency of anaemia was significantly higher among cases as compared to controls. Anaemic children were 1.6 times more prone to get LRTI.

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