ORIGINAL ARTICLE

The Prevalence of Anaemia and Its Associated Risk Factors in Children Admitted To General Paediatric Ward At Hospital Universiti Sains Malaysia, Kelantan

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ABSTRACT

Introduction: Anaemia is a common medical condition among children worldwide, yet a commonly overlooked health problem if not life-threatening. This study aimed to determine the prevalence of anaemia in hospitalized children and identify its associated risk factors. **Methods:** A retrospective study was conducted from January to December 2021 on 792 patients aged 6 months to less than 12 years old with acute illnesses, who were admitted to the general paediatric ward in Hospital Universiti Sains Malaysia. We analysed socioeconomic and demographic data, and risk factors associated with anaemia. **Result:** The overall prevalence of anaemia among children aged 6 months to less than 12 years old was 16.4%. The age group of 6 to 59 months has a significant association with anaemia with 3.73 odds compared to the age group of 5 to 11 years (Adj OR 3.73, 95% CI 2.53-5.49). Birth weight of more than 2.5kg has a significant association with anaemia with 1.80 odds compared to weight less than 2.5kg (Adj OR 1.79, 95% CI 1.12-2.88). **Conclusion:** The prevalence of anaemia in the studied population was considered as a mild public health problem according to WHO severity classification. Children aged 6 to 59 months and those with birth weight more than or equivalent to 2.5kg were more likely to be anaemic. Early iron supplementation should be taken into consideration to reduce anaemia in this population.
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INTRODUCTION

Anaemia is one of the most common medical condition among children globally. According to World Health Organization (WHO) data in the year 2019, the global anaemia prevalence was 39.8% (95% UI 36.0%, 43.8%) in children aged 6 to 59 months, equivalent to 269 million children with anaemia. Since the year 2000, the global prevalence of anaemia in children under five has slowly decreased over the years, from 48.0% (95% UI 45.1%, 51.0%) to 39.8% (95% UI 36%, 43.8%), and it remained static from the year 2010. In Malaysia, the overall prevalence of anaemia in 2019 for those aged 6 to 59 months was 24.6%, considered a moderate public health problem according to the WHO severity classification (1). Among Malaysian preschool and school-aged children, the South East Asia Nutrition Survey (SEANUTS) study reported that the prevalence of anaemia was 6.6% (2). On the other hand, some studies in several remote locations in Malaysia, have found that the prevalence of anaemia among Malaysian children ranged between 26.2% and 48.5% (3).

Anaemia is defined as a condition of insufficient red blood cells or haemoglobin concentration to meet physiological needs which can lead to various consequences including impaired cognition and behavioural problems. Haemoglobin concentration is the most reliable indicator of anaemia at the population level. Anaemia is defined as having haemoglobin level below the cut-off point according to different age ranges and sex as defined by WHO: (i) ≤10.9g/dL for 6 to 59 months old; (ii) ≤11.4g/dL for 5 to 11 years; and (iii) ≤11.9 g/dL for 12 to 14 years (4-6). Anaemia can be further classified into normochromic normocytic, hypochromic microcytic, and hyperchromic macrocytic by the mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) levels.

In Malaysia, various studies were conducted where most of them focused on iron deficiency anaemia (IDA) and

thalassaemia specifically. Studies published in Kelantan in 2006 and 2019 noted that the prevalence of anaemia and IDA among these children was high because of prolonged breastfeeding beyond six months of age (7). Birth weight, household size, height, weight, and body mass index were significantly associated with iron deficiency (ID) based on serum ferritin level (8).

Most of the studies were done in healthy individuals; whereas there was a lack of exploration on anaemia in children presenting with acute illness. This study is the first study done in the east coast of Malaysia to determine the prevalence of anaemia and its associated risk factors in hospitalized children. Knowing the risk factors associated with anaemia will provide huge input to the clinician particularly to detect and investigate the aetiology, focusing on the socio-economic and demographic background of patients. This will lead to more meticulous prevention and management of anaemia to reduce further complications.

Full blood count (FBC) is a routine investigation for children who require admission to the ward. This is a good opportunity to capture the data of these children at risk especially when they presented with concurrent acute illness. Anaemia is often a neglected issue in children admitted to the wards with acute illness, where most of us only focus on and treat the main presenting condition. Anaemia would not gain immediate attention if it is not life-threatening. Hence, the objective of this study is to determine the prevalence of anaemia, and its associated factors in children with acute illnesses, who were admitted to the general paediatric ward at Hospital Universiti Sains Malaysia.

MATERIALS AND METHODS

A cross-sectional study in the general paediatric ward was conducted at Hospital Universiti Sains Malaysia from January to December 2021. The study was approved by the Human Research and Ethics Committee (JEPeM), School of Medicine, Universiti Sains Malaysia (JEPeM Code: USM/JEPeM/21070508). Recruitment was performed after obtaining written informed consent from the parents or caregivers of the patients.

Clinical data of 792 children aged 6 months to less than 12 years old who were admitted to the general paediatric ward with acute illness, not known to have any underlying illness, were enrolled in this study. Information on socio-demographic data and risk factors for anaemia were obtained. According to the Department of Statistics Malaysia household income and basic amenities survey 2019, monthly household income in Malaysian Ringgit (MYR) was categorized into three groups: low (B40) as below MYR 4850; middle (M40) as between MYR 4850 and MYR 10959; and high (T20) as more than or equivalent to MYR 10960.

Haemoglobin level was retrieved from the patient's record as full blood count result from Emergency Department (ED) were usually attached with the patient's notes. The Sysmex XP-100 automated haematology analyser and Mindray BC-3000 Plus automated haematology analyser were used for the measurement of haemoglobin. Blood result that fulfilled the criteria for anaemia were included in this study.

Children with chronic illnesses or medical conditions lasting a year or more, and require ongoing medical attention or have limited activities of daily living, or both. (E.g. children with cerebral palsy, thalassaemia, chronic kidney disease, etc.) were excluded from the very beginning during data collection.

The sample size was determined using the formula: $n=Z^2p(1-p)/d^2$, where n is sample size, Z is value of standard normal distribution = 1.96, p is expected prevalence = 0.246, d is absolute precision = 0.05. A sample size of 285 was calculated by taking anaemia cases in children aged 6 to 59 months in Malaysia according to WHO (1). Hence, a total of 285 children with anaemia including 10 percent possible dropout participants have been determined as a sample size of this study. We performed a convenient stratified sampling from all patients admitted to our general paediatric ward who fulfilled the inclusion criteria, and further categorized them into anaemic and not anaemic groups.

Data were analysed using IBM SPSS Statistics for Windows version 26 software. Categorical data were presented as frequency and percentage while numerical data were presented as mean and standard deviation (SD). We applied simple logistic regression tests in the univariate analysis. All variables in the univariate analysis were selected for the multivariate analysis. A forward, backward, and manual method was used to determine our best final model. Then, we used a multiple logistic regression test to analyse the multivariate analysis. All variables with p-value less than 0.25 were selected for further processing. Subsequently, all selected variables were processed by forward LR, backward LR, and manual methods to achieve a parsimonious model for the study. All assumptions for the tests were met. Variables comparison with p-value less than 0.05 is considered significant.

RESULTS

A total of 792 patients aged from 6 months old to below 12 years old were involved in this study (Table I). The resulting data showed that the majority of patients aged 6 to 59 months (75.5%) were predominantly male gender (59%). Most of the patients were of Malay ethnicity (97.7%). Many patients whose parents with an education level below secondary school (71.1 – 73.7%)

Table I: Sociodemographic Characteristics and Disease of Diagnosis in Children Aged Six months to less than Twelve years old Admitted to General Paediatrics Ward, Hospital USM (n=792)

Variables	N	(%)
Age		
6 – 59 months	598	(75.5)
5 – 12 years old	194	(24.5)
Gender		
Male	467	(59.0)
Female	325	(41.0)
Ethnicity		
Malay	774	(97.7)
Non Malay	18	(2.3)
Father Education		
Below Secondary	584	(73.7)
College/University	208	(26.3)
Mother Education		
Below Secondary	563	(71.1)
College/University	229	(28.9)
Father Employment		
Employed	776	(98.0)
Unemployed	16	(2.0)
Mother Employment		
Employed	415	(52.4)
Unemployed	377	(47.6)
Household Income		
B40	596	(75.3)
>M40	196	(24.7)
Breastfeeding, months		
>6	628	(79.3)
<=6	164	(20.7)
Birth Weight, kg		
>=2.5	698	(88.1)
<2.5	94	(11.9)
Disease of Diagnosis		
Respiratory Tract Infection	276	(34.8)
Asthma	66	(8.3)
Acute Gastroenteritis	98	(12.3)
Febrile Seizure	116	(14.6)
Others	236	(30.0)

were more susceptible to anaemia compared to those parents who attended college or university. In this study, it was noted that most parents were employed (52.4% - 98%). Two-thirds of the patients (75.3%) were from a low socio-economic background. The majority of patients received prolonged breastfeeding for more than six months (79.3%). The most frequent diagnosis upon admission was respiratory tract infections (34.8%).

This study revealed that 130 children were anaemic, with the overall prevalence of anaemia among children aged 6 months to 12 years old was 16.4%. The prevalence of anaemia in children aged 6 to 59 months old and children aged 5 to below 12 years old were 18.5% and 9.8% respectively (Table II).

The simple logistic regression revealed that children aged 6 to 59 months (Crude OR 3.64, 95% CI: 2.48-5.36), parental education level (Crude OR 0.8, 95% CI:0.58-1.10), unemployed mothers (Crude OR 0.82, 95% CI:0.62-1.09), low household income (Crude OR 1.47, 95% CI:1.05-2.06), and birth weight of more than 2.5kg (Crude OR 1.65, 95% CI: 1.04-2.62) were significantly associated with anaemia (Table III).

In the multivariate analysis, the final model consisted of

Table II: Prevalence of Anaemia in Children Aged Six months to Less Than Twelve years old Admitted to General Paediatrics Ward, Hospital USM (n=792)

Variables	Anaemic (n=130) N (%)	Non Anaemic N (%)	p-value*
Age			0.004
6 – 59 months old	111 (85.4)	487 (73.6)	
5 – 12 years old	19 (14.6)	175 (26.4)	
Gender			0.206
Male	70 (53.8)	397 (60.0)	
Female	60 (46.2)	265 (40.0)	
Ethnicity			0.196
Malay	125 (96.2)	649 (98.0)	
Non Malay	5 (3.8)	13 (2.0)	
Father Education			0.050
Below Secondary	105 (80.8)	479 (72.4)	
College/Uni	25 (19.2)	183 (27.6)	
Mother Education			0.004
Below Secondary	106 (81.5)	457 (69.0)	
College/Uni	24 (18.5)	205 (31.0)	
Father Employment			0.492
Employed	129 (99.2)	647 (97.7)	
Unemployed	1 (0.8)	15 (2.3)	
Mother Employment			0.035
Employed	57 (43.8)	358 (54.1)	
Unemployed	73 (56.2)	304 (45.9)	
Household Income			0.014
B40	109 (83.8)	487 (73.6)	
>M40	21 (16.2)	175 (26.4)	
Breastfeeding			0.636
>=6m	101 (77.3)	527 (79.6)	
<6m	29 (22.3)	135 (20.4)	
Birth Weight			0.235
>=2.5kg	119 (91.5)	579 (87.5)	
<2.5kg	11 (8.5)	83 (12.5)	

*Chi square test

age and birth weight only. The children in the age group of 6 to 59 months had an association with anaemia with 3.73 odds compared to the age group of 5 to below 12 years (Adj 95% CI 2.53-5.49) when birth weight was controlled. Birth weight of more than 2.5kg had an association with anaemia with 1.80 odds compared to weight less than 2.5kg (Adj 95% CI 1.12-2.88) when age was controlled (Table IV).

DISCUSSION

Anaemia is a preventable medical condition. The WHO global anaemia prevalence was 39.8% in children aged 6 to 59 months, equivalent to 269 million children with anaemia in the year 2019. In Malaysia, the overall prevalence of anaemia in 2019 for those aged 6 to 59 months was 24.6%, considered a moderate public health problem according to the WHO severity classification (1). There were many studies on anaemia performed locally in Malaysia, however, to date, there was no study that assesses the prevalence, socio-economic and demographic factors associated with anaemia in hospitalized children. This study was conducted in a tertiary hospital located in Kota Bharu, the capital city of Kelantan and recruited a total of 792 patients aged from 6 months old to less than 12 years old who were admitted to the general paediatric ward for different acute illnesses. We excluded children aged above 12

Table III: Simple logistic regression of risk factors associated with anaemia in children aged six months to less than twelve years old admitted in General Paediatric ward, Hospital USM (n=792)

Variables	Crude Odd Ratio (OR)	95% (Lower,	CI Upper)	P-Value*
Age				
6 – 59 months old	3.64	2.47	5.36	<0.001
5 – 12years old	1			
Gender				
Male	1			
Female	1.01	0.76	1.35	0.926
Ethnicity				
Malay	1			
Non Malay	1.82	0.71	4.67	0.212
Father Education				
Below Secondary	0.8	0.58	1.10	0.171
College/Uni	1			
Mother Education				
Below Secondary	0.79	0.58	1.09	0.153
Col/Uni	1			
Father Employment				
Employed	1			
Unemployed	1.54	0.53	4.49	0.425
Mother Employment				
Employed	1			
Unemployed	0.82	0.62	1.09	0.179
Household Income				
B40	1.47	1.05	2.06	0.025
>M40	1			
Breastfeeding				
>6m	1			
<=6m	1.04	0.73	1.48	0.817
Birth Weight				
>=2.5kg	1.65	1.04	2.62	0.034
<2.5kg	1			

**Simple Logistic Regression*

Table IV: Factors associated with anaemia using multiple logistic regression

Variables	Adjusted Odd Ratio	95 % (Upper,	CI Lower)	p-value*
Age				
6 – 59 months	3.73	2.53	5.49	<0.001
5 – 12 years	1			
Birth Weight				
>=2.5kg	1.79	1.12	2.88	0.015
<2.5kg				

** Multiple Logistic Regression*
Constant = -1.916
Forward LR, Backward LR and manual method were applied
No multicollinearity and no interaction
Hosmer Lemeshow test, p-value= 0.092
Classification table 65.84% correctly classified
Area under Receiver Operating Characteristics (ROC) curve was 68.8 %

years old in our study as they had obtained the Malaysian identification card by then since hospitalisations for those above 12 years old would be admitted to the adult medical ward.

The prevalence of anaemia among children aged 6 to 59 months old and children aged 5 to less than 12 years old was 18.6% and 9.8% respectively. This finding was similar to a previous study done by Halib et al which showed the prevalence of iron deficiency anaemia in school children aged seven to nine years old was 7.7% in Kelantan (8). However a local study by Siti Noor et al reported a 65.1% prevalence of anaemia in children aged 6 to 26 months who visited eight primary health clinics in Kota Bharu, Kelantan for routine immunisation and healthcare follow up (7). Our result was not in line with the study performed among aboriginal school children by Al Mekhlafi et al in Pos Betau, Pahang which revealed that 48.5% of children have anaemia (10). The study done among Lebanese hospitalized children by Ali Salami et al revealed the majority of patients aged 6 to 59 months (71.9%) with more male patients (54.2%), with 33.2% prevalence of anaemia (9). Data comparison from other countries was higher in Namibia (49.6%) (14), Ethiopia (41.1% - 65.7%) (15,16), India (60.13%) (17). The difference in the prevalence might be due to variations in the study design, study period, and sample size. Besides, the difference in the geographical location of the study participants with various demographic and socioeconomic status also might contribute to the discrepancy of prevalence in anaemia.

The present data showed that the majority of patients were in the age range of 6 to 59 months with male predominance. Most of the patients were Malay (97.7%) as Kelantan is a state resided by the Malay population in the majority. These results were in line with the study done by Suria et al in 2020 where the prevalence of anaemia in children aged 6 to 59 months was 78% (13). Children of this age group have rapid growth rate with increased iron demands where lack of iron-rich foods renders children more susceptible to being anaemic (23).

Infants breastfed for more than six months without receiving iron supplementation are at risk of having anaemia. Healthy-term infants are born with sufficient iron stores to meet their needs during their first year of life. However, iron stores become depleted soon in infants exclusively breastfed beyond six months of age (24). Hence, early iron supplementation plays a protective factor against anaemia (25,26). In our practice, infants born prematurely were given iron, folate, and multivitamin supplementation upon discharge, therefore they were less likely to be anaemic compared to term infants who were not supplied with these haematinics during discharge.

In contrary to other studies, we did not find poor parental education as a risk factor associated with anaemia, which might be due to small variance in mother education level in a small sample size. Local studies demonstrated that low parental education levels were not significantly associated with anaemia in preschool and school-going children (7,8). The possible explanation for this finding could be that school-going children have greater autonomy about their food intake and they have to make their own choice of food at school (31). There are a variety of food with more iron bioavailability prepared at the school canteen such as red meat, poultry, seafood, and vegetables. However, dietary intake was not documented in this study and it needs to be further investigated. On the other hand, previous works of literature (19-23) showed that there was an association

between parental education levels and anaemia. Local studies done by Al-Mekhlafi et al (10) and Ngui et al (27) confirmed that low parental education level (especially mothers) was a significant predictor for anaemia among children in rural areas. Indeed, mother's education level carries a very important influence on dietary diversity and food security to prevent anaemia in their children as they were the main caregiver. Higher maternal education can improve mother's knowledge and increase awareness regarding childhood nutritional and health status, thus enabling them to select balanced diet for their children (11). A study by Choi et al in Korea found that children with more educated mothers were less likely to have anaemia (12).

This study also demonstrated that two-thirds of the patients were from a low socio-economic background (B40 category). Studies in Kelantan (7) revealed similar results in children from low-income families that had significance anaemia. Local studies from rural areas highlighted the impact of poverty on anaemia (10,27,28). The result was not in line with the study conducted by Suria et al where only 28.9% of patients were from the family of B40 category as there was a higher parental education level and higher income in Kepala Batas, Penang (13).

There were several limitations in this study. This was a single-centre study where the result does not reflect the true distribution of anaemia among the children population in Kota Bharu, Kelantan. The first FBC result obtained from ED was used to diagnose anaemia among children. Although this method is the most reliable indicator for anaemia, however, the present study did not aim to identify the aetiology of anaemia. There was a lack of other consecutive blood tests including serum ferritin, folate levels, vitamin B12 levels, and haemoglobin analysis which could determine the causes of anaemia. The association of anaemia with parasitic infections and other inflammatory markers were not analysed as well.

CONCLUSION

The prevalence of anaemia in the studied population was considered as a mild public health problem according to WHO severity classification. Children aged 6 to 59 months and those with birth weight more than or equivalent to 2.5kg were more likely to be anaemic. Early iron supplementation should be taken into consideration to reduce anaemia in this population. Further studies and interventions on detecting patients with anaemia and different types of anaemia, exploring their family background, history of hereditary anaemia, dietary intake, parasitic infestation, and infection status could be emphasized and taken care of in the future.

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