

# Prevalence of Anaemia and Malnutrition in Children $\leq 5$ Years of Age with Different Feeding Habits in Some Conflict Hit Zones of Fako Division in the South West Region of Cameroon: A Cross-Sectional Study on Roles of Nutritional Status

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## Abstract

The risk of malnutrition and anaemia in the first 5 years of life is still a severe public health problem. Addressing the influence of complementary feeding practice of mothers on nutritional status of children may be an important approach towards reducing the burden of child malnutrition and other health challenges, such as anaemia. Data on different infant feeding habits and its influence on the growth and health of children under five years are limited. The main objective of this study was to investigate the influence of infant feeding practices on the occurrence of malnutrition, anaemia and haematological profiles. A descriptive cross-sectional study was conducted from August 2016 to August 2018. A total of 1227 children  $\leq 5$  years of age were recruited. Socio-demographic factors and the different feeding habits of the children were assessed by the use of semi-structured questionnaire. Nutritional status was assessed by the use of anthropometric measurements and an auto haematology analyser was used to measure haematological parameters. Anaemia was classified based on the haemoglobin level measured according to WHO standards. The prevalence of exclusive breast feeding was 22.6%, mixed feeding 60.1% and 17.3% of the children were not breastfed at all. The prevalence of malnutrition and anaemia was 32.6% and 77.3% respectively. The prevalence of anaemia was significantly higher ( $P < 0.001$ ) in children with mixed feeding

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(80.5%) and was lowest for children who were exclusively breast fed (67.5%). Younger age, single parents, and parents with no formal education were associated with increased odds of anaemia in the children. Exclusive breast feeding should be encouraged in children up to 6 months of age.

### Keywords

Malnutrition, Anaemia, Haematological Profiles, Anthropometric Measurements

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## 1. Background of Studies

Anaemia is a condition where, due to low blood haemoglobin concentration [1], the oxygen carrying capacity of red cells is insufficient to meet the body's physiologic needs. This condition affects individuals globally and has significant adverse health consequences, as well as adverse impacts on social and economic development. Childhood anaemia is considered a severe public health problem in Sub-Saharan Africa (62.5%) and in Cameroon in particular, where prevalence of 63.2% was reported in 2011 [2]. Anaemia and malnutrition are two of the most common health problems affecting children. A 2008 WHO analysis reported that anaemia affected 24.8% of the world's population, including 42% of pregnant women, 30% of non-pregnant women and 47% of preschool children [3]. Most recently, global anaemia prevalence was estimated at 29% in pregnant women, 38% in non-pregnant women and 43% in children [4]. Worldwide, anaemia is attributed to 3 syndromes: iron deficiency (iron deficiency anaemia, hookworm infections, and schistosomiasis), hemoglobinopathy (sickle cell disorders and thalassemia) and malaria [5].

Malnutrition is one of the principal underlying causes of death for many of the world's children, contributing to more than a third of under-five deaths globally. About 178 million children globally are stunted and Africa has the highest rate [6]. Breastfeeding is a vital component for infant survival in developing countries [4]. In addition to its very important nutritional role, breastfeeding has been significantly associated with reduction of under-five morbidity and mortality, especially among those exclusively breast fed up to 4 and 6 months of age [7] [8]. WHO and United Nations Children's Fund (UNICEF) global strategy for optimal infant and young child feeding (IYCF) recommends the initiation of breastfeeding within one hour of birth, exclusively breastfeed for the first six months, after which nutritiously appropriate, adequate, and safe complementary foods should be introduced along with continuing breastfeeding up to two years and beyond [9]. It has been established that because of the best bioavailable iron in breast milk, exclusive breast-feeding prevents anaemia and infections, particularly diarrhoeal infections in the child.

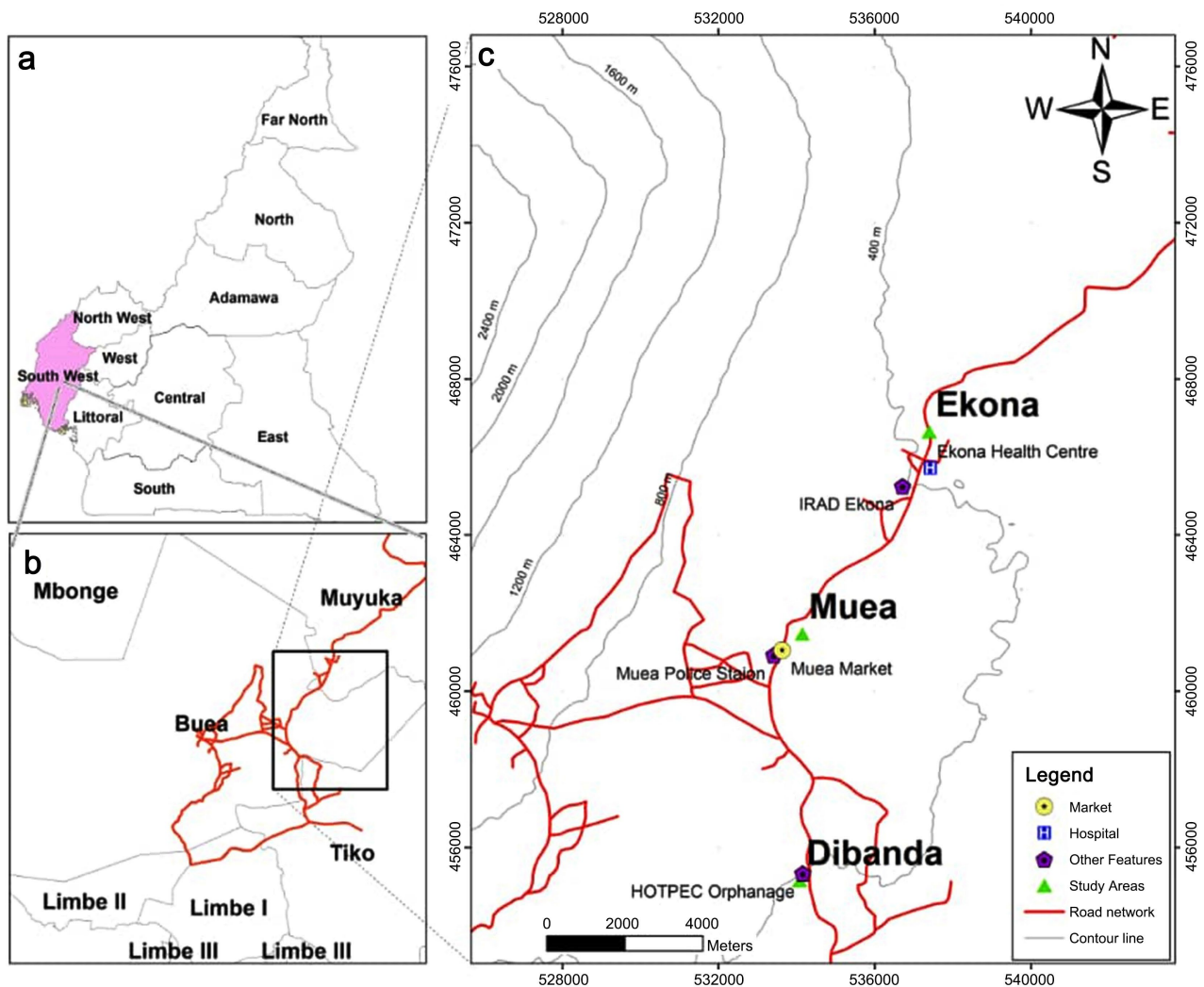
Although the primary cause of anaemia is iron deficiency [4], the prevalence and aetiology of anaemia in children  $\leq 5$  years of age have been infrequently studied in Cameroon. Consequently, the main objective of the study was to evaluate

the influence of different types of infant feeding habits such as EBF, no breast feeding (NBF) and mixed feeding (MF) on the occurrence of *Plasmodium falciparum* parasitaemia, malnutrition, and anaemia in children  $\leq 5$  years and to identify the challenges in the diagnosis of *P. falciparum* in the Mount Cameroon area.

## 2. Methodology

### 2.1. Study Area and Population

This study was carried out in the semi-rural communities of Muea, Ekona and Dibanda, situated at the foot of Mount Cameroon in the South West Region of Cameroon, as shown in **Figure 1**. Muea is a semi-rural setting in the rain forest ecozone on the Eastern flank of the active volcanic Mount Cameroon, and it is located 562 m above sea level at longitudes  $09^{\circ}18'53''\text{E}$  and latitudes  $04^{\circ}05'14''\text{N}$  and has been described in detail by [10]. The rainy season spans from March to October, and the dry season, characterized by frequent light showers, runs from November to February.



**Figure 1.** Map showing the different study areas.

Dibanda is located on the windward side of the eastern slope of Mount Cameroon with an altitude of 530 m above sea level, 25 km from the Atlantic Ocean, at longitude 09° 18' 47" E and latitude 04° 05' 09" N and has been described by [11].

Ekona has two distinct seasons: a cold, rainy season from March to October, and a warm, dry season with frequent light showers from November to February. It is located 898 m above sea level at longitudes 9° 20' 4" E and latitude 4° 14' 0" N. The majority of inhabitants are involved in farming, trading or livestock keeping. The two seasons of Ekona have been described in detail by [12].

All children  $\leq 5$  years of age resident in Muea, Ekona and Dibanda whose parents/caregivers consented to participate in the study were recruited. Children with severe malaria (unable to drink or breastfeed, vomiting more than twice in the preceding 24 hrs before presentation, recent history of convulsion, unconscious state or unable to stand and other diseases requiring hospital admission); Severe complications of malnutrition requiring hospitalization in intensive care or stabilization, including kwashiorkor; Known underlying chronic or severe disease (e.g., HIV/AIDS, TB, cardiac, renal or hepatic disease, sickle cell); Presence of febrile conditions due to other diseases which could alter the outcome of the study were excluded from the study.

## 2.2. Study Design

This observational cross-sectional study was carried out between the months of August 2016 and August 2018, including the rainy season (March-October). After obtaining ethical clearance and administrative and local authorizations from the chief and block heads in the neighbourhood, the study team proceeded to the field for sample collection.

### 2.2.1. Sample Size, Method and Sampling Unit

The minimum number of samples required for the study was calculated using the formula,

$$n = z_{\alpha/2}^2 (1 - a) P(1 - P) / d^2 \quad (1)$$

where  $n$  is the minimum sample size required;  $z$  is 1.96, which is the standard normal deviate;  $a$  is absolute precision at 5%;  $P$  is 66.2% which is the proportion of anaemia prevalence [13], and  $d$  is 0.05 (5%), the required margin of error. This gave a minimum sample size of 327 participants for each locality. Considering a possible participation of more than one child per family, loss of samples due to blood clotting and incomplete data entry, the sample size was adjusted by 10% to a minimum of 360.

A multi-stage sampling method was used in all the blocks in each neighbourhood in all three communities until the required sample was attained. At the start of the study in each site, the parents and guardians of the children were educated on the study protocol and the benefits of participation were highlighted at their various neighbourhoods. Ensuing administrative and ethical approval for the study, informed consent and assent forms explaining the purpose, risks, and ben-

efits of the study were given to parent/caregivers. Participants were invited to the data collection location in each community by their local chiefs, and coordination was organised by the block heads of the various communities. Upon obtaining consent/assent from the participants, semi-structured questionnaires were administered to the mothers/caregivers to get socio-demographic data and information on the different feeding methods. Following administration of the questionnaire, anthropometric measurements were obtained and the blood sample was collected from each child for a full blood count assessment.

### **2.2.2. Sample Collection and Laboratory Analysis**

#### **Questionnaire Survey**

Data was collected regarding the following: demographics (gender and age), feeding habits (exclusive breastfeeding and duration/mixed feeding/no breastfeeding), types of local weaning foods, mother's knowledge on balance diet, history of fever in the preceding 2 - 3 days, history of consumption of any medication in the preceding month, history of diarrhoea, availability of toileting facilities in household, sources of household water and parent/guardian educational level. Infants were classified as being exclusively breastfed using the definitions proposed by [14]. A child was said to be given mixed feeding (MF) when he/she was given a combination of breast milk and local infant formula before six months, and the last category of children were those who were not given breast milk (NBM) at all from birth and were fed with local infant formula.

#### **2.2.3. Clinical Evaluation**

Anthropometric measurements such as height and weight were measured using a measuring tape and a Terraillon weighing scale (Terraillon, Paris). The ages of the children were obtained from their mothers and caregivers. Under-nutrition indices such as height-for-age (HA), weight-for-age (WA), and weight-for-height (WH) standard deviation (SD) scores (Z scores) were computed based on the WHO growth reference curves using the WHO AnthroPlus for personal computers manual [4]. A child was identified as being malnourished if he or she scored  $<-2$  in one of the anthropometric indices of HA (stunting), WA (underweight) and WH (wasting) indices, while corresponding Z scores of  $<-3$  SD were considered indicative of severe under-nutrition [15].

#### **2.2.4. Collection of Blood Samples and Processing**

Four millilitres of venous blood samples were collected using sterile disposable syringes from children whose parents/caregivers signed the consent/assent forms. The collected blood was aliquoted into labelled ethylenediaminetetraacetate (EDTA) tubes. Labelled blood samples in EDTA tubes were transported on ice in a cool box to the Malaria Research Laboratory, University of Buea, for a full blood count analysis.

#### **2.2.5. Assessment of Haematological Parameters**

Haematological parameters were assessed using an auto-haematology analyser

(MINRAY 2800 BC), following the manufacturer's instructions. A complete blood count was obtained for haematological parameters such as haemoglobin levels, red blood cell counts (RBC), erythrocyte indices (mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and red cell distribution width (RDW), total white blood cell count (WBC) and platelet count (PLT). Anaemia was defined as Hb < 11.0 g/dL [WHO 2001] and further categorized as severe (Hb < 7.0 g/dL), moderate (Hb between 7.0 and 10.0 g/dL), and mild (>10 Hb < 11 g/dL).

### 2.3. Data Analysis

#### Statistical Analysis

Data was cleaned up and analysed using the IBM-Statistical Package for Social Sciences (IBM-SPSS) version 20. Continuous variables were summarized into means and standard deviations (SD), and categorical variables reported as frequencies and percentages were used to evaluate the descriptive statistics. The differences in proportions were evaluated using Pearson's Chi-Square ( $\chi^2$ ). Group means were compared using analysis of variance (ANOVA), Student's t-test, or Kruskal-Wallis test where appropriate. Significant levels were measured at 95% confidence interval (CI) with significant differences set at  $P < 0.05$ .

### 2.4. Ethics Statement

The study was approved by the Institutional Review Board hosted by the Faculty of Health Sciences, University of Buea (2021/004/UB/FHS/IRB) following administrative clearance from the South West Regional Delegation of Public Health, Cameroon. Informed consent/assent forms were given or read and explained to parents or caregivers of the children at presentation. The purpose and benefits of the study, as well as the amount of blood to be collected from each child, were clearly stated on the consent/assent forms. Only participants who gave written and/or verbal consent or assent took part in the study. Participation was strictly voluntary, and parents or caregivers were free at any point in time to stop the participation of the child/children in the study. All cases of moderate to severe anaemia as well as malnutrition were referred to the nearest health centre for appropriate treatment and follow-up, and the only little discomfort the children had was the pain perceived during blood collection from the vein.

## 3. Results

### 3.1. Characteristics of Study Participants

The socio-demographic and clinical characteristics of the study participants are shown in **Table 1**. A total of 1227 children with a mean (SD) age of 3.1 (1.6) years, residing in Ekona (35.5%, 436), Dibanda (31.9%, 391) and Muea (32.6%, 400) in the Mount Cameroon area were evaluated. The females were more (52.2%) than the males (47.8%), although not significantly. Participation within the age group was not significantly different, even though more of the children were of the  $\leq 2$

years (34.9%) age group. A greater proportion of the parents/guardians of the children (37.1%) had no formal education.

The prevalence of anaemia and malnutrition in children  $\leq 5$  years was 77.3% and 32.6% respectively. The most common form of malnutrition was stunting (27.1%).

The overall proportion of children who had EBF, MF and NBF from the 1227 children was 22.6%, 60.1% and 17.3% respectively. As shown in **Table 2**, the highest proportion of mothers who exclusively breast fed their children was from Muea (26.8%), followed by Dibanda (23.3%) and least from Ekona (18.1%). Significantly ( $P = 0.004$ ), most parents in the three study sites gave their children mixed feeding from birth. Among the 1196 children whose parent gave information on their educational level, a statistically significant ( $P < 0.001$ ) proportion of parents with tertiary education exclusively breastfed their children (34.0%) while, parents with no formal education had the highest proportion of children who were given mixed feeding (64.2%) and those not breast-fed (20.5%).

**Table 1.** Socio-demographic and clinical characteristics of study participants.

Parameter	Category	% (n)
Study sites	Ekona (n)	35.5 (436)
	Dibanda (n)	31.9 (391)
	Muea (n)	32.6 (400)
Sex	Female	52.2 (641)
	Male	47.8(586)
Age groups in years	$\leq 2$	34.9 (428)
	2.1 - 4.0	35.1 (431)
	4.1 - 5	30.0 (368).
Educational level of parent/caregiver	No formal	37.1 (444)
	Primary	26.8 (320)
	Secondary (n)	27.3 (326)
	Tertiary (n)	8.9(106)
Clinical	Mean age (SD) in years	3.1 (1.6)
	Mean weight (SD) in kg	14.39 (5.1)
	Mean height (SD) in cm	92.0 (18.2)
	Mean haemoglobin (SD) level in g/dL	9.9 (1.5)
	Anaemia prevalence	77.3 (948)
	Prevalence of malnutrition	32.6 (400)
	Prevalence of wasting	6.1 (75)
	Prevalence of underweight	10.4 (127)
	Prevalence of stunting	27.1 (333)
Feeding Practices	Exclusive breastfeeding	22.6 (277)
	Mixed feeding	60.1 (738)
	No breastfeeding	17.3 (212)

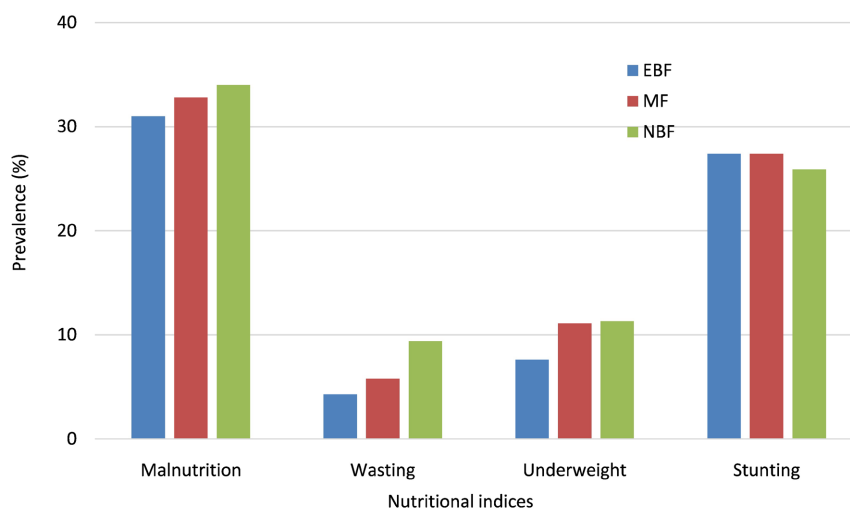
**Table 2.** Infant feeding methods as affected by study site and educational level of parent/caregiver.

Parameter	No. Examined	Infant feeding methods, % (n)			$\chi^2$ P-value	
		EBF	Mixed feeding	No breast milk		
Study site	Ekona	437	18.1 (79)	66.6 (291)	15.3 (67)	15.469 0.004
	Dibanda	390	23.3 (91)	59.7 (233)	16.9 (66)	
	Muea	400	26.8 (107)	53.4 (214)	19.8 (79)	
	Total	1227	22.6 (277)	60.1 (738)	17.3 (212)	
*Educational level of parent/caregiver	No formal	444	15.3 (68)	64.2 (285)	20.5 (91)	28.547 0.001
	Primary	320	25.6 (82)	60.0 (192)	14.4 (46)	
	Secondary	326	26.7 (87)	56.7 (185)	16.6 (54)	
	Tertiary	106	34.0 (36)	48.1 (51)	17.9 (19)	
	Total.	1196	22.8 (273)	59.6 (713)	17.6 (210)	

\*Information obtained from 1196 parents/caregivers only.

### 3.2. Infant Feeding Practice and Nutritional Status

Children who were not breastfed at all had similar prevalence of malnutrition (34.0%), with MF (32.8%) and exclusively breast-fed children (31.0%). Across the different forms of malnutrition, children who were not breastfed at all had the highest prevalence of wasting (9.4%) that approached significance ( $P = 0.058$ ) and underweight (11.3%) when compared with their counterparts (**Figure 2**).

**Figure 2.** Effect of infant feeding practice on nutritional indices.

The prevalence of malnutrition in EBF, MF and NBF children was comparable across the different age groups. However, the prevalence of malnutrition among MF children was highest in the  $\leq 2$  years age group (38.3%) and the difference was significant at  $P = 0.001$ , as shown in **Table 3**.

**Table 3.** Undernutrition prevalence as affected by sex and age among children with different feeding methods.

Parameter	Feeding Method						Test statistics	
	EBF % (n)		MF % (n)		NBF % (n)			
Age ≤2	90	33.3 (30)	261	38.3 (100)	77	41.6 (32)	$\chi^2 = 1.255$ , P = 0.534	
Age 2.1 - 4.0	94	37.2 (35)	260	35.4 (92)	77	32.5 (25)	$\chi^2 = 0.425$ , P = 0.808	
Age 4.1 - 5.0	93	22.6 (21)	217	23.0 (50)	58	25.9 (15)	$\chi^2 = 0.247$ , P = 0.884	
Test statistics	$\chi^2 = 5.014$ P = 0.081		$\chi^2 = 13.766$ P = 0.001***		$\chi^2 = 3.755$ P = 0.153		-	
Sex	Male	132	33.3 (44)	355	33.0 (117)	99	35.4 (35)	$\chi^2 = 0.201$ , P = 0.905
	Female	145	29.0 (42)	383	32.6 (125)	113	32.7 (37)	$\chi^2 = 0.707$ , P = 0.702
Total	277	31.0 (86)	738	32.8 (242)	212	34.0 (72)	$\chi^2 = 0.132$ , P = 0.936	
Test statistics	$\chi^2 = 0.616$ P = 0.433		$\chi^2 = 0.009$ ** P = 0.926		$\chi^2 = 0.160$ P = 0.689			

\*\*statistically significant at P < 0.01; \*\*\*statistically significant at P < 0.001.

On the other hand, the prevalence of malnutrition in EBF, MF and NBF children was similar in the different sexes. Also, the prevalence of malnutrition was similar in males and females among EBF, MF and NBF children.

### 3.3. Influence of Infant Feeding Practice on Anaemia and Severity in the Study Population

The prevalence of anaemia was significantly higher (P < 0.001) in children who had MF (80.5%) when compared with EBF (67.5%) children. The prevalence of severe and moderate anaemia was significantly higher among NBF (6.6%, 67.1%) when compared to their counterparts at P = 0.029 as revealed in **Table 4**.

**Table 4.** Effect of infant feeding practice on anaemia prevalence and severity.

Parameter	No. examined	Prevalence of anaemia (n)	Anaemia severity			
			Severe % (n)	Moderate % (n)	Mild % (n)	
Infant Feeding practice	EBF	277	67.5 (187)	3.7 (7)	56.7 (106)	39.6 (74)
	MF	738	80.5 (594)	4.0 (24)	56.9 (338)	39.1 (232)
	NBF	212	78.8 (167)	6.6 (11)	67.1 (112)	26.3 (44)
Test statistic	$\chi^2$	19.645		10.753		
	P-value	0.001***		0.029*		

\*Statistically significant at P < 0.05; \*\*\*statistically significant at P < 0.001.

The effect of age and sex on the prevalence of anaemia stratified by feeding habit is represented in **Table 5**. The prevalence of anaemia varied significantly with age across the different feeding methods (EBF: P < 0.001; MF: P = 0.001; and NBF: P = 0.01). Children who were EBF had a significantly lower (P < 0.001) prevalence

of anaemia when compared with those who had other feeding methods among the 4.1 - 5.0 years old children. However, the prevalence of anaemia across the different feeding methods was comparable among the  $\leq 2$  and 2.1 - 4.0 years children.

**Table 5.** Prevalence of anaemia as affected by sex and age among children with different feeding methods.

Parameter	Feeding Method						Test statistics
	EBF % (n)		MF % (n)		NBF % (n)		
Age $\leq 2$	90	81.1 (73)	261	87.7 (229)	77	89.6 (69)	$\chi^2 = 3.244, P = 0.197$
Age 2.1 - 4.0	94	71.3 (67)	260	76.9 (200)	77	75.3 (58)	$\chi^2 = 1.187, P = 0.552$
Age 4.1 - 5.0	93	50.5 (47)	217	76.0 (165)	58	69.0 (40)	$\chi^2 = 19.617, P < 0.001^{***}$
Test statistics	$\chi^2 = 20.412$ P < 0.001 <sup>***</sup>		$\chi^2 = 13.580$ P = 0.001 <sup>***</sup>		$\chi^2 = 9.293$ P = 0.010*		-
Sex Male	132	72.0 (95)	355	85.4 (303)	99	75.8 (75)	$\chi^2 = 12.954, P = 0.002^{**}$
Sex Female	145	63.4 (92)	383	76.0 (291)	113	81.4 (92)	$\chi^2 = 12.429, P = 0.002^{**}$
Total	277	67.5 (187)	738	80.5 (594)	212	78.8 (167)	$\chi^2 = 19.645, P < 0.001^{***}$
Test statistics	$\chi^2 = 2.288$ P = 0.130		$\chi^2 = 10.306$ P = 0.001 <sup>***</sup>		$\chi^2 = 1.010$ P = 0.315		

\*Statistically significant at  $P < 0.05$ ; \*\*\*statistically significant at  $P < 0.001$ .

The prevalence of anaemia varied significantly within sex across the different feeding habits, with the males (72.0%) and females (63.4%) who were EBF having significantly lower ( $P = 0.002$ ) prevalence of anaemia. The prevalence of anaemia was significantly higher in males (85.4%) than in females among MF children ( $P = 0.001$ ) only, when the sexes were compared (Table 5).

### 3.4. Haematological Indices in Study Population

The mean haematological values for  $WBC \times 10^9/L$ ,  $RBC \times 10^{12}/L$ , Hb (g/dL), HCT (%), MCV (fL), MCH (pg), MCHC (g/L), RDW-CV (%), PLT (L) among the children in the study area was 8.2 (2.3), 4.1 (1.4), 9.9 (1.5), 26.8 (4.3), 67.7 (7.0), 24.8 (4.0), 36.8 (5.0), 13.1 (3.8), 253.2 (130.1) respectively. The mean haematological parameters were comparable for the different sexes, except for haemoglobin concentration and haematocrit levels. The mean haemoglobin concentration (9.7 g/dL) and haematocrit levels (26.3%) were significantly lower in males when compared to females ( $P < 0.001$ ), as shown in Table 6.

### 3.5. Haematological Indices and Feeding Habits

Overall, the mean haematological parameters were comparable between children EBF, MF and NBF except for the  $RBC \times 10^{12}/L$  counts, Hb levels (g/dL), haematocrit levels (%), MCH (pg) and RDW-CV (%) as shown in Table 7. Children NBF had significantly lower mean  $RBC \times 10^{12}/L$  counts [3.9 (1.0)], HB levels (g/dL) [9.6 (1.5)], HCT levels [26.0 (4.5)] and platelet count  $\times 10^9/L$  ( $235.8 \pm 119.5$ ).

**Table 6.** A comparison of mean haematological indices in the different sexes.

Parameter	Sex	N	Mean (SD)	t-test	N	Total Mean (SD)
				P value		
WBC × 10 <sup>9</sup> /L	Male	586	8.2 (2.3)	0.30	1227	8.2 (2.3)
	Female	641	8.2 (2.3)	0.976		
RBC × 10 <sup>12</sup> /L	Male	586	4.0 (0.9)	-1.898	1227	4.1 (1.4)
	Female	641	4.2 (1.8)	0.058		
Hb (g/dL)	Male	586	9.7 (1.5)	-3.714	1227	9.9 (1.5)
	Female	641	10.0 (1.4)	<0.001***		
HCT (%)	Male	586	26.3 (4.4)	-3.965	1227	26.8 (4.3)
	Female	641	27.3 (4.1)	<0.001***		
MCV (fl)	Male	586	67.5 (7.2)	-1.131	1227	67.7 (7.0)
	Female	641	67.9 (6.8)	0.258		
MCH (pg)	Male	586	24.8 (3.6)	-0.671	1227	24.8 (4.0)
	Female	641	25.0 (4.3)	0.502		
MCHC (g/L)	Male	586	36.9 (4.4)	0.839	1227	36.8 (5.0)
	Female	641	36.7 (5.5)	0.402		
RDW-CV%	Male	586	13.3 (5.0)	1.911	1227	13.1 (3.8)
	Female	641	12.9 (2.1)	0.056		
PLT × 10 <sup>9</sup> /L	Male	586	251.1 (120.0)	-0.535	1227	253.2 (130.1)
	Female	641	255.1 (138.8)	0.593		

**Table 7.** A comparison of mean haematological indices in different feeding methods.

Variable	Feeding methods	N	Mean (SD)	95% CI of difference	ANOVA
					P value
WBC × 10 <sup>9</sup> /L	EBF	277	8.1 (2.2)	7.8 - 8.3	F = 1.339 P = 0.262
	MF	738	8.2 (2.4)	8.1 - 8.4	
	NBF	212	8.0 (2.1)	7.7 - 8.3	
RBC × 10 <sup>12</sup> /L	EBF	277	4.3 (2.4)	4.0 - 4.6	F = 5.010 P = 0.007**
	MF	738	4.1 (1.0)	4.0 - 4.1	
	NBF	212	3.9 (1.0)	3.8 - 4.0	
Hb (g/dL)	EBF	277	10.2 (1.4)	10.1 - 10.4	F = 11.894 P < 0.001***
	MF	738	9.9 (1.4)	9.7 - 10.0	
	NBF	212	9.6 (1.5)	9.4 - 9.8	
HCT (%)	EBF	277	27.5 (4.3)	27.0 - 28.0	F = 7.036 P = 0.001**
	MF	738	26.9 (4.2)	26.6 - 27.2	
	NBF	212	26.0 (4.5)	25.4 - 26.6	
MCV (fl)	EBF	277	67.9 (7.6)	67.0 - 68.8	F = 0.889 P = 0.411
	MF	738	67.5 (6.8)	67.0 - 68.0	
	NBF	212	68.2 (6.7)	67.3 - 69.1	
MCH (pg)	EBF	277	25.2 (4.3)	24.7 - 25.7	F = 3.400 P = 0.034*
	MF	738	24.6 (4.0)	24.4 - 24.9	
	NBF	212	25.3 (3.6)	24.8 - 25.8	

## Continued

MCHC (g/L)	EBF	277	37.0 (5.7)	36.3 - 37.7	F = 1.568 P = 0.209
	MF	738	36.6 (4.9)	36.3 - 37.0	
	NBF	212	37.2 (4.5)	36.6 - 37.9	
RDW-CV (%)	EBF	277	13.0 (2.5)	12.7 - 13.3	F = 0.277 P = 0.758
	MF	738	13.1 (4.5)	12.8 - 13.5	
	NBF	212	13.0 (2.0)	12.7 - 13.2	
PLT × 10 <sup>9</sup> /L	EBF	277	243.0 (130.6)	227 - 258	F = 4.468 P = 0.012*
	MF	738	262.0 (132.1)	252.5 - 271.5	
	NBF	212	235.8 ± 119.5	219.6 - 252.0	

\*Statistically significant at  $P < 0.05$ ; \*\*statistically significant at  $P < 0.01$ ; \*\*\*statistically significant at  $P < 0.001$ .

### 3.6. Anaemia Prevalence and Severity in the Study Population

#### 3.6.1. Influence of Demographic Factors on the Prevalence and Severity of Anemia

The overall anaemia prevalence in the study population was 77.3%. Although not significant, the prevalence of anaemia was lowest in Muea. Practically, difference between Ekona and Dibanda was minimal. The prevalence of anaemia was significantly higher in males (80.7%) and children  $\leq 2$  years of age (86.7%) when compared with members of their respective clusters, as shown in **Table 8**. Relating to the severity of anaemia, the prevalence of severe and moderate anaemia was highest in males (5.7%, 60.3%), children  $\leq 2$  years of age (6.2%, 61.7%) at  $P = 0.049$  and  $P < 0.001$  respectively (**Table 8**).

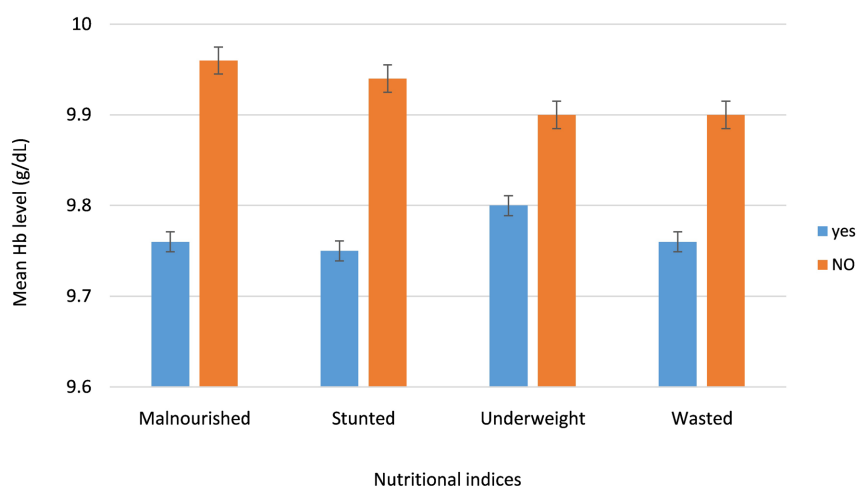
**Table 8.** Prevalence and severity of anaemia as affected by study site, age and sex.

Variable	No. examined	Anaemia prevalence	Anaemia Severity				
			No. examined	Severe % (n)	Moderate % (n)	Mild % (n)	
Site	Ekona	437	78.3 (342)	342	6.1 (21)	57.6 (197)	36.3 (124)
	Dibanda	390	80.0 (312)	312	4.5 (14)	58.3 (182)	37.2 (116)
	Muea	400	73.5 (294)	294	2.4 (7)	60.2 (177)	37.4 (110)
Level of sig.	$\chi^2 = 5.123, P = 0.077$		$\chi^2 = 5.303, P = 0.258$				
Sex	Male	586	80.7 (473)	473	5.7 (27)	60.3 (285)	34.0 (161)
	Female	641	74.1 (475)	475	3.2 (15)	57.1 (271)	39.8 (189)
Level of sig.	$\chi^2 = 7.622, P = 0.006$		$\chi^2 = 6.017, P = 0.049^*$				
Age group	$\leq 2$	428	86.7 (371)	371	6.2 (23)	61.7 (229)	32.1 (119)
	2.1 - 4	431	75.4 (325)	325	4.9 (16)	60.3 (196)	34.8 (113)
	4.1 - 5	368	68.5 (252)	252	1.2 (3)	52.0 (131)	46.8 (118)
Level of sig.	$\chi^2 = 38.626, P < 0.001^{***}$		$\chi^2 = 20.892, P < 0.001^{***}$				

\*\*\*Statistically significant at  $P < 0.001$ .

### 3.6.2. Malnutrition, Stunting and Mean Haemoglobin Levels

As shown in **Figure 3**, malnourished children had significantly lower mean haemoglobin levels when compared with well-nourished children ( $P = 0.027$ ). In addition, stunted children had a significantly lower mean haemoglobin level when compared with non-stunted ( $P = 0.037$ ). The mean haemoglobin level was lower among underweight and wasted children, although the difference was not significant ( $P = 0.443$  and  $P = 0.431$  respectively).



**Figure 3.** Mean Hb profile with respect to malnutrition, stunting, underweight and wasting.

### 3.6.3. Risk Factors of Malnutrition in the Study Population

The logistic regression model with malnutrition as the dependent variable and age, gender, level of education and marital status of guardian, anaemic status as well as infant feeding methods as the independent variables revealed age as the only significant predictor. Children  $\leq 2$  years and those between 2.1 and 4.0 years were 1.73 and 1.59 times respectively, more likely to be undernourished than children between 4.1 and 5.0 years old, as shown in **Table 9**.

**Table 9.** Logistic regression model examining factors associated with malnutrition in children.

Variable	N	Malnutrition prevalence (n)	Bivariate		Multivariate	
			COR	P value	COR	P value
Age group (Years)						
4.1 - 5.0	368	23.4 (86)	Reference		Reference	
2.1 - 4.0	431	35.3 (152)	1.79	<0.001	1.73	0.008
$\leq 2$	428	37.9 (162)	2.00	<0.001	1.59	0.028
Gender						
Female	641	31.8 (204)	Reference		Reference	
Male	586	33.4 (196)	1.08	0.545	-	-

**Continued**

		Marital status				
Married	302	27.8 (84)	Reference		Reference	
Single	894	33.9 (303)	1.33	0.051	1.10	0.669
		Infant feeding habits				
EBF	277	31.0 (86)	Reference		Reference	
MF	738	32.8 (242)	1.08	0.60	-	-
NBF	212	34.0 (72)	1.14	0.49	-	-
		Anaemic Status				
No	279	27.2 (76)	Reference	Reference	-	-
Yes	948	34.2 (324)	1.39	<b>0.03</b>	1.22	0.385

P values in bold are statistically significant.

## 4. Discussion

### Feeding Practices in the Study Population

This cross-sectional study examines the influence of feeding practices on the occurrence of malnutrition and anaemia in children  $\leq 5$  years in the Mount Cameroon area. This study showed that the rate of exclusive breast feeding is 22.6% in this area as compared to the 28.2% in Cameroon in 2014 by the World Bank [16]. The lower rate in this study could be attributed to the fact that most of the study participants had not gotten any form of formal education and as a result of this, were not aware of the important role feeding a child exclusively on breast milk in the first six months of life had to do with the building of the child's immune system and the fight against opportunistic infections.

Overall, 77.4% of the children in the study areas were introduced to complementary food before the recommended age of 6 months. This high frequency is similar to studies in Nasarawa, Nigeria, where 69% - 82% children were reported to have been introduced to complementary foods before 6 months [17]. The significantly low practice of EBF among parents with no formal education may also be attributed to their lack of information on the importance of EBF and the wrong perceptions mothers have about feeding their kids with breast milk only for the recommended duration of 6 months. Majority of mothers in the study areas perceived that the baby was not satisfied with breast milk and felt the need for early commencement of complementary feeding. Early introduction to solid foods, early cessation of breastfeeding and increased consumption of fatty or sugary foods at 1 year of age are generally risk factors for infection [18].

It was shown that most of the mothers with a tertiary education level exclusively breastfed their infant according to the recommendation of the WHO, compared to mothers who had no form of education. Similar to these findings, a study done by [19] reported that child feeding practices, including exclusively breastfeeding were improved among college-educated mothers compared to those mothers with high school education. Consistent with a study done by [20], there was a high

tendency to initiate exclusive breastfeeding among mothers with an intermediate level of schooling (>3 to =6 years) compared to mothers with no formal education (<1 year). On the contrary, Niger *et al.* (2010), reported that uneducated mothers breastfed their children for a longer duration than educated mothers.

Findings from the study showed that 77.3% of infants  $\leq 5$  years of age in the Mount Cameroon area were anaemic, indicating anaemia is a severe public health problem based on the WHO classification [21]. The higher prevalence of anaemia in this study is similar to the high prevalence (73.4%) reported by [22].

The aetiology of anaemia is multifactorial hence, the high prevalence of anaemia could also be attributed to the fact that, most of the mothers in this study areas are farmers and they abandon their children back home at very tender ages and most of their farm products are taken to the market to sell and hence the children are not well fed and taken care of. In addition to this, the high prevalence could also be a result of the socio-economic instability in Cameroon that has affected mostly the farmers in the rural and semi-rural communities. Most of the farmers have been internally displaced from their farmlands and are seeking refuge in nearby cities. Consequently, most of their farm products have been abandoned in the bushes, and the number of inhabitants in a household is too large, thereby making it difficult to provide good nutrition for the children.

Over 45.31% of the infants suffered from moderate anaemia. These results are consistent with the results of other studies of anaemia among infants in the same area [23]. Male children were more anaemic than female children, which is similar to other reports [24] and contrary to other studies, which found no association between anaemia and gender [25]. An association with boys may be due to the faster growth of pre-school boys compared to girls, which results in a high iron demand that cannot be met by diet alone [25]. However, further studies are necessary to better understand this factor.

The high anaemic status of children given complementary food before 6 months could be attributed to the fact that, the mothers/care givers in these study sites abandoned their children home to go to farms at a very early age and most often the children are not properly fed by the people under whose care they are placed. In 2011, WHO reported that, infant and young child feeding practice is suboptimal throughout the world especially the late initiation of breastfeeding, prelacteal feeding, early or late introduction of optimal complementary foods, giving poor quality, quantity and unhygienic complementary food, and using a bottle to feed the child are the common practices in developing countries [26] [27]. Adequate nutrition during infancy and early childhood is essential to ensure the growth, health and development of children to their full potential [28]. Hence, the first two years of life provide a critical window of opportunity for prevention of growth faltering and under-nutrition through optimal feeding [29].

Findings from the study revealed that breastfeeding exclusively for up to 6 months of age is associated with significantly lower rates of anaemia among children. This could be as a result of the fact that, the mothers who practiced EBF on

their children were mainly house wives who did not go to work or farms and hence had adequate time to properly breastfeed their children for up to 6 months. Other studies have identified weaning after 6 months as a risk factor for iron deficiency anaemia in resource-limited countries, where infants are more likely to have lower iron stores at birth [30] [31]. Furthermore, this study revealed that children from single parents were at higher risk of anaemia than children from married parents. This could be attributed to the fact that most single women abandon their children with caregivers and go in search of greener pastures as opposed to married women, hence most often the children are not given proper attention.

Malnutrition is a multi-dimensional entity. The nutritional status of children under the age of five is affected by different factors. The present study identifies only age as risk factor for malnutrition. Children  $\leq 2$  years and those between 2.1 and 4.0 years were 1.73 and 1.59 times respectively, more likely to be undernourished than children between 4.1 and 5.0 years old. This is contrary to other studies which found that the educational status of the parents, not the age of the child, was associated with the nutritional status of the child [32]. This could be explained by the fact that children between the ages of 4.1 to 5 years can feed on a wide variety of diets prepared at home and do not rely only on soft local weaning foods.

This study revealed age group ( $P < 0.001$ ), marital status ( $P < 0.001$ ) and educational level of parents ( $P < 0.001$ ) as significant predictors of anaemia. Children  $\leq 2$  years of age and single parents were 2.25 and 6 times, respectively, more likely to be anaemic than their counterparts. In addition, children from guardians with no formal, primary and secondary level of education were 4, 34 and 88 times respectively, more likely to be anaemic than children from guardian with tertiary level of education. Previous studies conducted in Tanzania [33]-[35] also showed a higher risk of anaemia among non-educated women, single women and children below the age of 2 years. It is possible that non-educated and single women have lower access to health information and healthcare facilities compared to educated and married women. It is also possible that children below 2 years of age are still very selective with food and have limited access to what they eat and solely depend on what their guidance or caregivers provide for them.

## 5. Conclusions

Anaemia is still a severe public health problem among children  $\leq 5$  years of age in this area, especially among children  $\leq 2$  years of age, children from single-parent families and those without any formal education. Iron supplementation should be given to infants who are given complementary feeding before the first six months of life in order to reduce the prevalence of anaemia within the first six months of age.

Local weaning foods from this Mount Cameroon area are good for children's normal nutrition and growth if enriched with iron, folic acid, handled with optimum care and given adequately. This is because these local weaning foods have mineral and vitamin contents well above the values recommended to cover the

Recommended Daily Allowance. Furthermore, these local weaning foods produced in the Mount Cameroon area have acceptable microbiological loads. The prevalence of exclusive breastfeeding in the Mount Cameroon area is low, and many mothers lack awareness of the importance of breast milk.

### Recommendations

The government should encourage and supervise the production of local weaning foods from communities, ensuring that they are well fortified with iron and folic acid.

The communities should make good use of local cash crops in the production of weaning foods and always ensure that they are balanced by carrying out an adequate nutritional evaluation.

The government/community should encourage EBF in local communities by training personnel and sending them into the communities to meet the rural population.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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