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Prevalence of Anemia and Associated Socio-Economic Determinants amongst Malnourished Children Aged 6-59 Months, Centre Hospitalier Universitaire de Kigali (CHUK) – A Retrospective Observational Study

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ABSTRACT

INTRODUCTION: In Rwanda, malnutrition among children under five years is a major public health problem. Anemia is one of the comorbidities of malnutrition.
This study aimed to investigate the prevalence of anemia in a hospitalized malnourished pediatric population aged under 5 years and associated socio-economic factors.
METHODS: This was a retrospective cross-sectional study of malnourished children aged 6-59 months consulted and admitted in CHUK during the time of review, January-December 2017. Data were collected from patients' files and OpenClinic (an electronic medical record system). The collected data were recorded and calculated means and frequencies using SPSS version 16.0. The cutoff points for anemia in children were based on hemoglobin (Hb) concentration whereby less than 7g/dL, 7-9.9g/dL, and 10-11.5 g/dL were considered severe, moderate and mild anemia, respectively while hemoglobin concentration above 11.5 g/dL was considered normal based on WHO (2001) recommendations.
RESULTS: A total of 113 patients were enrolled. Of those, 66% (n=74) were male and 34% (n=39) were female. The mean age was 27 months. We have found that 15% were stunted and 18.6% were wasted, while 24.8% were underweight. Accordingly, 69% (n=78) of study population were found to be anemic with whom 8.8% were severely anemic (Hb <7g/dL), 30.1% were moderately anemic (Hb 7-9.9g/dL), 30.1% were mildly anemic (Hb 10-11.5 g/dL) and 31% (n=35) were not anemic (Hb >11.5 g/dL). Low education status of parents, poverty, consuming cow's milk before one year of age, and a high number of siblings (greater than 3) in the household were descriptively found to be predictors of socio-economic determinants of malnutrition associated with anemia.
CONCLUSION: The significant relationship between increased prevalence of nutritional anemia among children with malnutrition and socio-economic factors, like illiteracy, nutrition and poverty, were identified. Enhancement of social protection services and basic education for all could curb the problem.

Keywords: Malnutrition, Anemia, Socio-economic Determinants, Prevalence, Rwanda

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INTRODUCTION

Malnutrition is defined by the World Health Organization (WHO) as deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients [1]. It is estimated that approximately 19.4% of children aged under 5 years are underweight, and 29.9% of children are stunted in developing countries [2]. A study done in the northern part of Ethiopia indicated that 33% of children aged 12–23 months were stunted [3]. While a study among school children in the northwest part of Ethiopia also indicated that 15.1%, 25.2%, and 8.9% of children were underweight, stunted, and wasted, respectively [4]. In Uganda, the prevalence of stunting among children under five years of age has dropped from 38% in 2006 to 33% in 2011. Additionally, malnutrition is the underlying cause of as many as 45% of child deaths in Uganda [5]. Rwanda Demographic and Health Survey (RDHS) (2015) reported that 38% of Rwandan children under age five are short for their age or stunted [6]. Childhood malnutrition has significant physiological, physical and cognitive effects on childhood and adulthood development. It is the foremost risk factor for the global burden of disease, including anaemia [7,8].
Anaemia is a global health burden of disease in both developing and developed countries [9]. Globally, anemia affects 1.62 billion people, corresponding to 24.8% of the general population [10]. Moreover, the report from World Health Organization (WHO) has revealed that the highest anemia prevalence is in pre-school age children while the lowest prevalence is in adult men [11]. Globally, in preschool-age children, the prevalence of anaemia is 47.4%, affecting 293 million children worldwide. The highest prevalence is in Africa and South-East Asia, where 67.6% and 65.5% are anemic, respectively [12]. In the Eastern Mediterranean, the prevalence is 46% and around 20% in the other WHO regions, including America, Europe and Western Pacific. Additionally, anemia is affecting 305 million school-age children, corresponding to 25.4% [13].

The study conducted in Cape Verde on the prevalence of anemia in children aged below five years has concluded that anemia among children is a major public health issue as high as 51.8% of children under five are anemic [14]. On the other hand, 82% and 69.3% of under-five years paediatric population are anemic in Benin and Equatorial Guinea, respectively [15]. In Rwanda, 37 % of Rwandan children age 6-59 months have some level of anemia, including 21% who are mildly anemic, 15% who are moderately anemic, and 1% with severe anemia [16].
Study aim: Though the prevalence of anemia in the general pediatric population is still high, no specific data is revealing the prevalence of anemia in malnourished children and less more in children admitted to hospitals with malnutrition in Rwanda. Our study aimed to determine the prevalence of anemia and associated determinant factors for malnourished children admitted at CHUK.

METHODS

Study design: This was a retrospective cross-sectional study that analyzed the files of the malnourished pediatric patients aged between 6-59 months who have been admitted to CHUK from January 2017 to December 2017. This manuscript followed the RMJ STROBE checklist [17]
The study was conducted in the Pediatric Department of Centre Hospitalier Universitaire de Kigali (CHUK). The CHUK is the biggest referral public hospital located in Kigali City, with a catchment area covering almost 70% of referrals of Rwanda.
Study population: The study population considered all malnourished children less than five years of age admitted to the pediatric department during the study period.
All children admitted in the pediatric department aged between 6-59 months had malnutrition based on the WHO criteria.
Any patient who was suspected of having malnutrition but not confirmed.
Data collection: Data were extracted from patient's files based on the pre-established questionnaire by researchers. The records were retrieved from the Hospital's Medical Records Department in CHUK Pediatric Unit. The relevant information was collected from each retrieved case file and/or hospital registers during the study period under review and transferred onto a designed Data Collection Form.
Anemia: Anemia in children under five years is defined as hemoglobin <11.50 g/dL, hematocrit <34% and MCV <71.9fL [18]. The anemia was measured and classified using the hemoglobin

level of the pediatric population whereby hemoglobin levels below 7g/dL were considered to be severe anemia, between 7-9.9 g/dL were considered moderate anemia, 10-11.5 g/dL mild anemia while hemoglobin ranging above 11.5 g/dL were considered normal [11].

Malnutrition: The WHO defines malnutrition as an imbalance between the supply of protein and energy and the body's demand for them to ensure optimal growth and function [19].

Stunting: Defined by Length/Height-for-age Z-score (LAZ) with height for age <- 2 SD of the WHO Child growth standards median

Wasting: Defined by Weight-for Length/height Z-score (WLZ) with weight for height <- 2 SD of the WHO Child growth standards median

Underweight: Defined by Weight-for-Age Z-score (WAZ), with weight for age <- 2 SD of the WHO Child Growth Standards median

Data analysis: The collected data were computed using World Health Organization (WHO)-recommended guidelines [16,20,21]. The data were then transferred to SPSS statistical packages version 16.0 for analysis.

This study was purely descriptive and a description was made to determine the associations between independent and dependent variables. The relationship between anemia and other variables was also described: The degree of anemia by sex and age, the association between anemia and household economy and other socio-economic factors, and the relationship between anemia and maternal education level.

The hemoglobin level less than 11.5g/dL was taken as a dependent variable

Independent variables included sex and gender of the child, the mothers' socio-economic status, and nutritional status. The socio-economic factor has been splinted into different components includes educational status, sustainable source of income and marital status of the mothers. The anthropometrical indices were expressed as standard deviation values (Z-scores), which are most useful for statistical analysis (Parvanta, 1994). The WHO Anthro 2005 software (World Health Organization Geneva, Switzerland) was used to calculate the Z-scores.

Ethical considerations: No physical, social, emotional, legal and/or financial risks were identified. Personal data was not used in the analysis. Each patient was assigned a unique study identifier number. A password-protected linking study ID and personal identifier (name, hospital ID) were kept separately by the principal investigator (PI). Only the researcher and the research team had access to the study data and information.

Only patient files were consulted; therefore, no informed consent was sought for this study

There were no incentives offered to patients whose data were used in this study.

The research protocol was reviewed and approved by the Ethics committee of CHUK (Ref: EC/CHUK/619/2018).

RESULTS

Of the 652 admitted children, 113 met our inclusion criteria. Of those, 66% (n=74) were males while 34% (n=39) were females. The mean age of the children was 27.4 months (Figure 1).

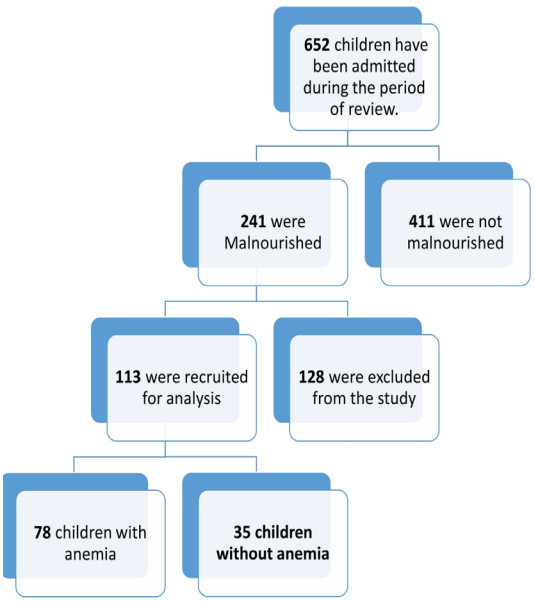

Figure 1: Recruitment and screening

Of the participated pediatric patients, 53.1% were exclusively breastfed for six months and above, 23.9% were breastfed exclusively below six months, while 23.0% were fed cow's milk below one year of age. Among stunted children, 64.7% were males, while females were 35.3%. For wasting, 61.9% of males were wasted while wasting in females stands at 38.1% while for underweight; always males were at risk whereby among children with underweight, 71.4% of them were males. 33.6% of children were living in the city of Kigali

(Table 1). 45.1% of mothers whose children were participated in this study were uneducated (Table 2). Regarding to the sustainable source of income, 28.3% of mothers of participated children are unemployed. 46.9% of mothers/parents have been found to have greater than three children (Table 2).

More than two-third of the malnourished children, 69% (n=78), were found to be anemic. According to the types of anemia, microcytic anemia is highly prevalent among malnourished children (58.4%). The anemia was found to be more common in males than in females.

This study revealed that the mothers of 52.5% of anemic children have never attended schools. In comparison, mothers of 29.5% of anemic children have completed primary education. Anemia is less likely in the pediatric population whose mothers attended secondary and tertiary education levels, 10.2% and 7.8%, respectively. Of the anemic malnourished children, 78.1% were born from families with a sporadic source of income, while only 21.7% were born from mothers with a sustainable source of income. The nutritional history was also found to significantly affect nutritional anemia prevalence to the extent that 24.3% of anemic children were given cow's milk before reaching one year of age. The number of siblings in the household was also associated with anemia in malnourished children as 61.5% anemic children had greater than three siblings. There is no relationship found for other factors like parents' separation or orphanage to affect the anemia among malnourished children.

Of our study population, 53.1% have been exclusively breastfed for six months, 23.9% breastfed exclusively less than six months, while 24.3% have been fed cow's milk during the infancy period. Being a retrospective study, it is difficult to

Table 1: Characteristics of participated children with malnutrition, January - Dec 2017 (n=113)

Variables	Frequency	Percentage
Sex of the Child		
Male	74	65.5
Female	39	34.5
Age of the Child (months)		
Between 6-23	55	48.7
Between 24-41	35	31.0
Between 42-59	23	20.4
Residence		
Kigali	38	33.6
South	17	15.0
North	29	25.7
East	17	15.0
West	12	10.6
Nutritional History of the Child		
Exclusive breastfeeding greater than 6 months	60	53.1
Exclusive breastfeeding less than 6 months	27	23.9
Given Cow's milk at an age below one year	26	23.0
Nutritional status		
Stunted	17	15.0
Wasted	21	18.6
Underweight	28	24.8

Table 2: Characteristic of the mothers, January - Dec 2017 (n=113)

Variables	Frequency	Percent
Educational status of the mother		
Uneducated	51	45.1
Primary level	40	35.4
Secondary level	15	13.3
Tertiary level	7	6.2
Number of siblings in the household		
Greater than 3 Siblings	53	46.9
Less than 3 siblings	60	53.1
Employment status of the mother		
Unemployed	32	28.3
Employed	30	26.5
Farmer	51	45.1
Marital status of the Parents/Guardians		
Married	91	80.5
Divorced	3	2.7
One or both parents Deceased	19	16.8

quantify the amount of cow's milk given daily, but such nutrient has played a vital role in developing nutritional anemia among our study population. Of those given cow's milk below one year of age, 40% were severely anemic, 26.5% moderately anemic, 17.6% mildly anemic, and 20% were having normal hemoglobin.

DISCUSSION

This study was conducted to assess the prevalence of anemia and associated socio-economic determinants among malnourished children aged 6-59 months. The prevalence of anemia was found to be 69% which is relatively higher than the anemia in the general pediatric population without malnutrition in Rwanda (37.0 %) [6]. This finding of having a high prevalence of anemia in the malnourished pediatric population compared to the general population is supported by studies conducted in Brazil and Tanzania [22,23].

The findings revealed that microcytic anemia is highly prevalent among malnourished children with 58.4%; normocytic anemia was 39.8%, while macrocytic anemia was 1.8%. This finding is consistent with that of a study conducted in India to assess the prevalence and type of anemia among children with severe acute malnutrition [24]. We have found that anemia is more common in males than in females. This finding is supported by the study done in the Philippines [25]. The anemia prevalence has been found to decrease with age dramatically. High prevalence was found in the children aged between 6-23 months, while the lowest prevalence is in the age group of 42-59 months. This finding is similar to the study conducted in Ethiopia in 2014 [26].

This may be attributable to lower iron requirements per kilogram body weight associated with decreasing growth rate and the shift in the diet from complementary foods to table foods. The household income, level of parents' education, nutritional history during early childhood, and number of siblings, among others were found to be the associated socio-economic determinants of anemia among malnourished children aged less than five years.

As it has been highlighted, iron deficiency anemia is most prevalent among malnourished children and most of them used cow's milk as their main source of nutrition during infancy. This fact implies the fact that cow's milk has low iron content. Cow's milk and its consumption during infancy are associated with occult intestinal blood loss and the inhibition of non-heme iron absorption by

calcium and casein, both of which are present in high amounts in Cow's milk [27].

The therapeutic approach of anemia in the settings of our study was not standardized. Some children were treated without being investigated, iron and folate supplementation was supplemented without being investigated, others micronutrients wherever necessary were not given. Blood transfusion practice was not the scope of our study, anemic children with malnutrition who have been transfused have received furosemide in mid transfusion, and this practice is not supported with the literature.

In this study, we have found that 78.1% of malnourished anemic children were born from families whose source of income is sporadic. Similar findings have been found in the studies conducted in Brazil and Ethiopia [22], [28]. This is because children from low-income families are less likely to get iron-rich foods and food insecurity, leading to malnutrition. Additional socio-economic factors found to be associated with anemia in malnourished children are the educational status of the parents, nutritional history and number of siblings in the household.

In this study, we have found that 24.3% of anemic children were given cow's milk before reaching one year of age. Being retrospective in nature, this study did not quantify the amount of cow's milk given daily, but the literature suggests giving more than 750ml of cow's milk daily to an infant to be an increased risk of developing iron-deficiency anemia [29]. The theory reflects this that cow's milk has low iron content; cow's milk consumption during infancy is associated with occult intestinal blood loss as well as the inhibition of non-heme iron absorption by calcium and casein, both of which are present in high amounts in Cow's milk [30].

Our study, being retrospective, the data were only dependent on what was documented in the files and consequently, we were unable to meet the parents to clarify the associated socio-economic determinants of nutritional anemia in their children.

CONCLUSION

The prevalence of anemia among malnourished children aged between 6-59 months was found to be 69.0%. Descriptively, we have found that children born from families with poor socio-economic status are highly likely to be malnourished and develop nutritional anemia. We, therefore, recommend policymakers should focus on poverty reduction interventions and other social protection programs to ensure food security within Rwandan families.

Interventions such as education have the potential to enhance the educational status of the population, and thereafter parents will be able to prepare balanced diets for their kids and enhance Family planning use. As far as the treatment options, these are not standardized in our settings, a robust sensitization to diagnose and treat every malnourished child according to WHO ten-steps is advised. Iron supplementation for children can be beneficial, as we have seen that microcytic anemia is the most prevalent type of anemia in malnourished children.

This should be tested systematically in all children with malnutrition. Blood transfusion is another treatment option that should be focused on in some settings. Raising community awareness on nutritional education, exclusive breastfeeding for at least the first six months of life, family planning as well as no use of cow's milk among children under one year of age may also contribute to the reduction of the national burden of both malnutrition and nutritional anemia among children under 5-years-of-age.

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