



RESEARCH ARTICLE

**REVISED** Prevalence and factors associated with anemia among children under five years of age in Rombo district, Kilimanjaro region, Northern Tanzania [version 3; peer review: 1 approved, 2 approved with reservations]

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**Abstract**

**Background:** Anemia is a severe public health problem affecting more than half of children under five years of age in low-, middle- and high-income countries. The study aimed to determine the prevalence and factors associated with anemia among children under five years of age in northern Tanzania.

**Methods:** This community-based cross-sectional study was conducted in Rombo district, Kilimanjaro region, northern Tanzania, in April 2016. Multistage sampling technique was used to select a total of 602 consenting mothers and their children aged 6-59 months and interviewed using a questionnaire. Data were analyzed using Stata version 15.1. We used generalized linear models (binomial family and logit link function) with a robust variance estimator to determine factors associated with anemia.

**Results:** Prevalence of anemia was 37.9%, and it was significantly higher among children aged 6-23 months (48.3%) compared to those aged 24-59 months (28.5%). There were no significant differences in anemia prevalence by sex of the child. Adjusted for other factors, children aged 6-23 months had over two times higher odds of being anemic (OR=2.47, 95% CI 1.73, 3.53, p<0.001) compared to those aged 24-59 months. No significant association was found between maternal and nutritional characteristics with anemia among children in this study.

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**Conclusion:** Prevalence of anemia was lower than the national and regional estimates, and it still constitutes a significant public health problem, especially among children aged 6-23 months. The study recommends iron supplementation, food fortification, dietary diversification, and management of childhood illnesses interventions for mothers and children under two years.

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article can be found at the end of the article.

### Keywords

Anemia, prevalence, risk factors, under five children, Tanzania



This article is included in the **Sociology of Health gateway**.

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**REVISED Amendments from Version 2**

There are minor edits in the citations while some parts of the discussion have been revised with two additional citations for clarity.

**Any further responses from the reviewers can be found at the end of the article**

## Introduction

In children under five years, anemia is a significant public health problem in the low-, middle- and high-income countries. The world health organization (WHO) defines anemia as a low blood hemoglobin concentration of less than 11g/dl in children under five years of age<sup>1,2</sup>. Anemia in children is a major cause of adverse health consequences such as stunted growth, impaired cognitive development, compromised immunity, disability and increased risk of morbidity and mortality<sup>2-11</sup>. Globally, about 43% of children under-five are anemic, and there is a marked variation in the prevalence of anemia between low- and middle-income countries (LMIC). Over 50% of anemic children live in LMIC<sup>12</sup>, and the highest prevalence rate (78%) was reported in Ghana and the lowest (26%) in Cuba<sup>13,14</sup>. According to WHO, the African region has the highest proportion (62%) of anemic children<sup>12</sup>.

A variety of factors causes anemia, but the most common cause is iron deficiency<sup>1,3,12</sup>. Iron deficiency can result from inadequate dietary intake or poor absorption, increased needs for iron during the high growth periods, and increased iron losses due to helminths infection<sup>3</sup>. Other causes of anemia can be infections like malaria, genetic makeup, and nutritional deficiencies of vitamins B12, A, C and folate<sup>3</sup>. Factors associated with anemia also vary from region to region. The factors include the area of residence (whereby children living in rural areas being more at risk), low education level of the mother, child's sex (high among males), child's age (below 24 months) and history of infections, high birth order and maternal history of anemia<sup>1,4,13-20</sup>. Unemployment, low family income, low wealth quartile and high poverty index have also been associated with anemia in children under five<sup>5,9,15,17</sup>. In addition, poor breastfeeding practices and complementary feeding leads to anemia<sup>7,14-16</sup>.

To combat anemia in children, WHO recommends combined strategies such as iron supplementation, especially to vulnerable populations, food-based approaches to increase iron intake through food fortification and dietary diversification and management of infectious diseases, particularly malaria and helminth infections<sup>21</sup>. These strategies are recommended to be built into the primary health care system and existing programs such as maternal and child health, integrated management of childhood illness, adolescent health, safe motherhood, roll-back malaria, deworming and tuberculosis<sup>21</sup>. Improved quality of anemia care is also among key strategies to accelerate progress towards addressing this problem<sup>22</sup>. Although Tanzania is implementing these strategies<sup>23</sup>, the Demographic and Health Survey (DHS) report shows no improvement in reducing anemia prevalence. For the two consecutive DHS

rounds, 2010 and 2015, the prevalence of anemia was 58%. The results of the DHS show that the country is still far from reaching the set target of reducing anemia prevalence to 20% by 2020. In the Kilimanjaro region, Same District, anemia prevalence was 70%<sup>19</sup>. Since studies show variations in factors that are associated with anemia, there was a need to conduct this study in the Rombo district as an important step towards evidence-based decision-making when planning for interventions. Geographically Same is semi-arid district while Rombo is located around Mount Kilimanjaro, hence having different topographic conditions.

## Methods

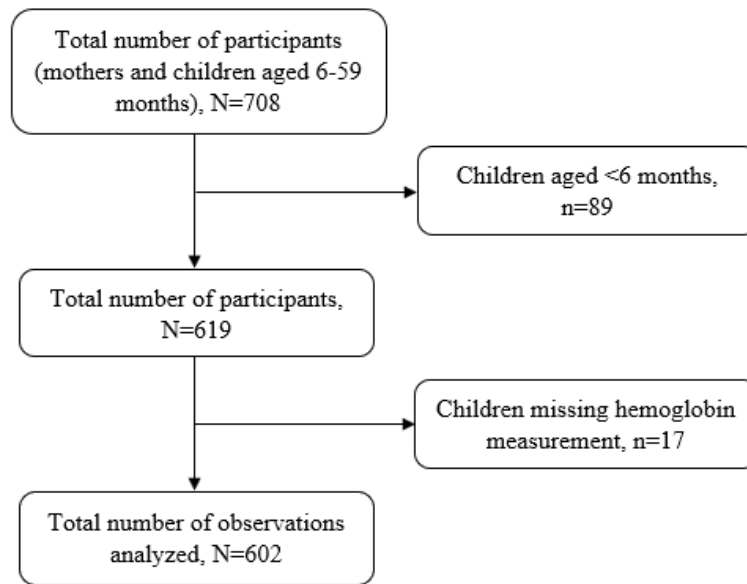
### Study design and setting

This study utilized data from a community-based cross-sectional study conducted in Rombo district, Kilimanjaro region, northern Tanzania in April 2016. Rombo district is one of the seven districts of the Kilimanjaro region. The study aimed to assess the nutritional status of children under five years in the district. The district is bordered to the north and east by Kenya, to the west by Siha and Hai districts and to the south by Moshi rural district. According to the 2012 national population and housing census, Rombo district had a total population of 260,963 of which 124,528 (52.3%) were females while 29,955 were children under five years of which 14,971 (50%) were females<sup>24</sup>. The district's largest population depends on agriculture, livestock keeping, small petty business, and few people are employed in the public sector. The district has 43 health facilities: 2 hospitals, four health centers and 37 dispensaries<sup>25</sup>.

### Study population, sample size, and sampling

The study included consenting mothers and their children aged 6–59 months. A single proportion formula was used for sample size calculation. Using a standard normal value of 1.96 under 95% confidence interval, a 48% prevalence of anemia among children 6–59 months in Kilimanjaro region<sup>2</sup>, a margin of error of 5% and multiplying by a design effect of 1.5 to account for cluster design, the minimum required sample size was 575 mother-child pairs.

Multistage sampling technique was used to select 708 mother-child pairs from households with children aged 6–59 months. Two villages were randomly selected from each randomly selected ward. A listing of households with children under five years was generated with the help of village leaders or link persons, followed by a random selection of households. Systematic random sampling was used to select households. When the visited household had no child under five years of age, the next household was selected until the minimum required sample size was reached. If there were more than one child aged 6–59 months, the younger one was selected to represent the rest of the children in the household. If the child's mother was not at home, the research team visited the house a minimum of three times before declaring that the participant could not be reached. Children whose mothers were not available on the day of data collection were excluded from the study as it was not possible to verify child information if next in kin or neighbor was interviewed. In addition, after excluding 89 children aged <6 months and 17 with missing hemoglobin concentrations, we analyzed data for 602 mothers-child pairs [Figure 1](#).



**Figure 1.** Schematic diagram showing the number of participants.

### Data collection methods

A questionnaire, shared as extended data<sup>26</sup>, was used to collect data during face-to-face interviews. Although the questionnaire has not been validated in Tanzania, we adopted questions from the DHS and added some from previous literature. The following information was collected; maternal reproductive health, breast-feeding history, feeding patterns, initiation of complementary feeding, use of health facilities during pregnancy and child nutrition status. The questionnaire was in both English and Swahili languages but administered using the Swahili language, a language spoken by all the local people in this setting. Trained medical student at the Kilimanjaro Christian Medical University College collected data under the Institute of Public Health supervision.

### Study variables and measurements

The dependent variable in this study was anemia. Anemia was defined as a blood hemoglobin concentration below 11.0 g/dl in children under five years of age<sup>1</sup>. Blood samples were drawn among children from a drop of blood taken from a finger prick or heel prick (for children aged 6–11 months) and collected in a microcuvette strip. Hemoglobin (Hb) was measured on-site using a portable HemoCue rapid testing method (HemoCue® Hb 301 Analyzer - HemoCue AB, Kuvettgatan 1, SE-262 71 Angelholm, Sweden). The anemia results were given on-site and children with severe anemia (hemoglobin level <7 g/dL) were referred to the nearby health facilities.

The independent variables included socio-demographical characteristics such as age of the mother in years (<20, 20–29 and 30+), education level, occupation (Peasant/farmer, Employed and Others), marital status (single, married/cohabiting and divorced/ separated/ widowed), area of residence (rural and urban depending on how the locals define them), alcohol

consumption (Yes and No), body mass index (BMI) of the mother (underweight (<18.5Kg/m<sup>2</sup>); normal weight (18.5–24.9 Kg/m<sup>2</sup>), overweight (25–29.9 Kg/m<sup>2</sup>), and obese (≥30 Kg/m<sup>2</sup>); and child's age and sex. Nutritional characteristics included exclusive breastfeeding (Yes and No)<sup>27</sup>, colostrum feeding (Yes and No), meal frequency per day (≤3 meals and >3 meals), age at initiation of complimentary feeding (<6 months and 6+ months), and use of deworming drugs past six months (Yes and No).

Measurement of weight was performed using a SECA weighing scale (SECA GmbH & Co. KG, Hamburg, Germany) while recumbent length was measured for children aged <24 months and standing height was measured for older children using stadiometers. At least two measurements were taken then the average was calculated. Stunting, wasting, and underweight (height-for-age, weight-for-height z-score, and weight-for-age z-score below minus two standard deviations (-2 SD), respectively) from the median of the WHO reference population<sup>2</sup>. Child anthropometric z-scores were calculated using the 2006 WHO child growth standards through the “zscore06” package in Stata<sup>28</sup>.

### Ethical consideration

Ethical approval was obtained from Kilimanjaro Christian Medical University College Research and Ethics Review Committee (KCMU-CRERC). Permission to conduct the study was also sought from the Rombo District Authority. Before data collection, logistics meetings were held with ward and village leaders of selected sites to inform them about the study's purpose. The study purpose was explained to mothers before enrolment. Those who agreed to participate provided written informed consent. Unique identification numbers were used to ensure the anonymity of participant information.

## Statistical analysis

Data were analyzed using [Stata](#) version 15.1, StataCorp LLC. Means and standard deviations were used to summarize numeric variables while frequency and percentages for categorical variables. Chi-square ( $\chi^2$ ) test was used to compare the prevalence of anemia by participant characteristics. Odds ratio (OR) and 95% confidence intervals (CIs) were used to determine factors associated with anemia in children using generalized linear models (GLM) with binomial family and logit link function adjusted for potential confounding. Akaike information criteria (AIC) was used to select the best model. The GLM model with binomial family and log link function was favored against the log-linear model, i.e., Poisson family with log link function hence all the analyses were performed using the former model. A robust variance estimator was used to account for model misspecification hence improving precision of estimates. The stepwise regression method was used to select variables included in the adjusted analysis at the 10% threshold level. The age of the child remained the only significant predictor of anemia at this stage. Maternal age, alcohol use (statistically significant in the crude analysis), sex of the child, and child's nutritional characteristics, specifically exclusive breastfeeding, wasting, stunting, and underweight, were considered potential confounders, hence included in the final model.

## Results

### Background characteristics of mothers and children

Data were analyzed for a total of 602 mothers and children aged 6–59 months. The mean age (SD) of mothers in this study

was 29.9±7.6 years. More than half (52%) of all mothers were aged between 20–29 years, 70% had primary school education level, 81.3% were married or cohabiting with their partners. The prevalence of obesity among women was 14.3%. The median age (IQR) of children in this study was 24 (14, 36) months while more than half (52.5%) were aged between 24–59 months. Also, more than half (52.7%) of all children were males [Table 1](#)<sup>29</sup>.

### Feeding practices and nutritional status of children

The vast majority (96.3%) were given colostrum while the overall prevalence of exclusive breastfeeding up to six months was 40.1%. Less than half (45.2%) of children in this study were given more than three meals per day and 69.7% were initiated complimentary feeding before six months. Also, 70.5% of children in this study were given deworming drugs. This study's prevalence of wasting, stunting, and underweight was 10%, 38.5%, and 6%, respectively [Table 2](#)<sup>29</sup>.

### Prevalence of anemia by child's age and sex

In this study, the mean (SD) hemoglobin level of children aged 6–59 months was 11.2±1.6g/dl and the prevalence of anemia (hemoglobin level less than 11g/dl) was 37.9%. Prevalence was slightly higher among females (39.7%) compared to 36.2% among males [Figure 2](#)<sup>29</sup>, but this difference was not significant (p=0.40). Prevalence was much higher among children aged 6–23 months (48.1%) compared to 28.5% among those aged 24–59 months [Figure 3](#)<sup>29</sup>. These differences in the prevalence by age were statistically significant (p<0.001).

**Table 1. Background characteristics of mothers and children (N=602).**

Variables	Frequency	Percentage
<b>Age categories of the mother in years*</b>		
Mean (SD)	29.9 (7.6)	
<20	19	3.2
20–29	307	52.0
30+	264	44.8
<b>Education level*</b>		
None	13	2.2
Primary	420	69.9
Secondary and above	168	28.0
<b>Marital status*</b>		
Single	73	12.2
Married/Cohabiting	487	81.3
Divorced/ separated/ widowed	39	6.5
<b>Occupation*</b>		
Peasant/farmer	366	64.9

Variables	Frequency	Percentage
Employed	160	28.3
Others	38	6.7
<b>Area of residence</b>		
Urban	27	4.5
Rural	575	95.5
<b>Body mass index categories*</b>		
Normal	285	47.9
Underweight	26	4.4
Overweight	199	33.4
Obese	85	14.3
<b>Consume alcohol</b>		
No	367	60.9
Yes	235	39.0
<b>Attended ANC during pregnancy for this baby*</b>		
No	13	2.2
Yes	585	97.8
<b>Number of ANC visits* (n=585)</b>		
≥4	382	65.8
<4	199	34.2
<b>Sex of the child</b>		
Male	317	52.7
Female	285	47.3
<b>Age of the child (months)</b>		
Median (IQR)	24 (14, 36)	
6–23	286	47.5
24–59	316	52.5

\*Variable with missing information.

### Factors associated with anemia

The study performed crude and adjusted analyses to determine factors associated with anemia in children aged 6–59 months. In the crude analysis, factors associated with anemia were whether the mother consumed alcohol, exclusive breastfeeding, and child's age [Table 3<sup>29</sup>](#). Lower odds of anemia were observed among children whose mothers consumed alcohol (OR=0.68, 95%CI 0.48, 0.95, p=0.03). Higher odds of anemia were observed among children who were breastfed exclusively (OR=1.53, 95%CI 1.09, 2.14, p=0.02) and children aged 6–23 months (OR=2.34, 95%CI 1.67, 3.28) compared to those aged 24–59 months which showed a much stronger association with anemia

(p<0.001). There was a positive association between stunting and the odds of anemia (OR=1.39, 95%CI 0.99, 1.95) but this association was not strong (p=0.06), [Table 3<sup>29</sup>](#).

Adjusted analysis for factors associated with anemia in children is shown in [Table 4<sup>29</sup>](#). A multivariable model was developed by adding and later removing one variable after another to assess the presence and effect of confounding. Age of the child was the only variable that remained to be strongly (p<0.001) associated with higher odds of anemia. Adjusted for mother's age categories (years), whether a mother consumed alcohol during pregnancy, exclusive breastfeeding,

**Table 2. Nutritional characteristics (N=602).**

Variables	Frequency	Percentage
<b>Child given deworming drugs*</b>		
No	171	29.5
Yes	408	70.5
<b>Baby given colostrum*</b>		
No	22	3.7
Yes	577	96.3
<b>Meal frequency per day*</b>		
≤3	321	54.8
>3	265	45.2
<b>Age at complementary feeding*</b>		
<6 months	375	69.7
≥6 months	163	30.3
<b>Child exclusively breastfed*</b>		
No	349	59.9
Yes	234	40.1
<b>Wasted</b>		
No	542	90.0
Yes	60	10.0
<b>Stunted</b>		
No	370	61.5
Yes	232	38.5
<b>Underweight</b>		
No	566	94.0
Yes	36	6.0

\*Variable with missing information

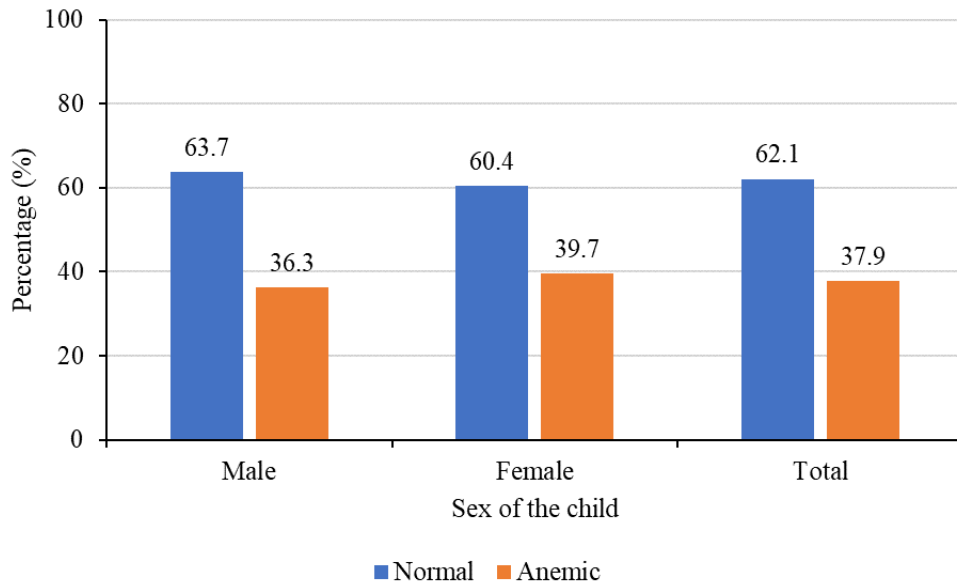
wasting, stunting and child's sex, children aged 6–23 months had over two times higher odds of being anemic (OR=2.47, 95%CI 1.73, 3.53) compared to those aged 24–59 months [Table 4](#)<sup>29</sup>.

## Discussion

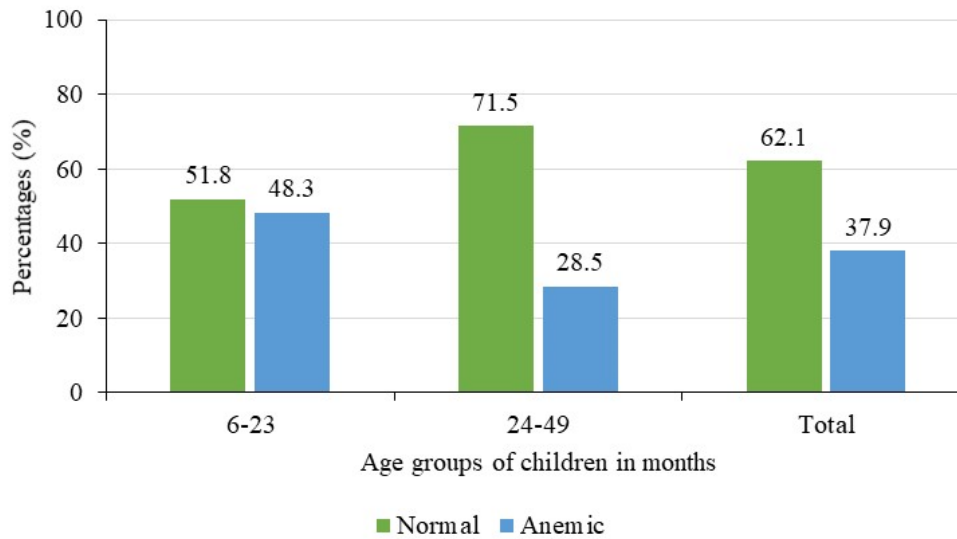
The prevalence of anemia among children aged 6–59 months in this study was 37.9%. Age of the child was the only factor significantly associated with anemia among children. This study's prevalence of anemia in this study is much lower than the national and regional estimates<sup>2</sup> and other sub-population studies in Tanzania<sup>9,19</sup>. One of these studies was hospital-based<sup>9</sup>, while the other included children aged 1–35 months<sup>19</sup> that could explain the differences. Prevalence in this study is also lower

than those reported in other countries<sup>5,13,15,16,30</sup>. High prevalence in other studies could be linked to differences in the study population and wider population coverage since most utilized nationally representative data such as DHS data. A study by Ayoya *et al.* observed a similar prevalence (39%) among under-five children in Haiti<sup>4</sup>. Pita *et al.* observed a lower (26%) prevalence in Cuba<sup>14</sup>, which may be due to food-fortification interventions among other strategies<sup>14</sup>. Despite the observed differences, the prevalence reported in this study constitutes a significant public health problem<sup>12</sup> that needs intensified efforts.

In this study, adjusted for the background and nutritional characteristics, children aged 6–23 months had higher odds of having anemia than those aged 24–59 months. Infants



**Figure 2.** Prevalence of anemia by sex of the child (N=602).



**Figure 3.** Prevalence of anemia by age groups of children in months (N=602).

(<24 months) are consistently reported to be at higher odds of being anemic in other studies<sup>2,4,5,13,14,31,32</sup>. Infants have a higher demand for nutrients needed for their growth, hence need proper complementary feeding. In this setting, there is a practice of giving porridge (a mixture of water, maize flour, and added sugar), cow’s milk and less diversified foods at a younger age<sup>33</sup>. This practice could be one of the factors that leads to poor anemia status in children<sup>33,34</sup>. Also, conflicting advice on infant

and young child feeding from various sources, including close relatives, community members, and health care providers affects breastfeeding practices, impacting the child’s anemia status<sup>34</sup>. Receiving quality anemia care, particularly nutrition advice about healthy foods and the minimum acceptable diet to the care giver, and routine hemoglobin measurement is critical in reducing anemia burden for children 6–23 months, who are most at risk<sup>22</sup>.



**Table 3.** Crude analysis for factors associated with anemia in children under five (N=602).

Variables	N	Anemic (%)	COR*	95% CI	p-value
<b>Age categories of the mother in years</b>					
<20	19	9 (47.4)	1.58	0.62, 4.01	0.34
20–29	307	119 (38.8)	1.12	0.79, 1.56	0.56
30+	264	96 (36.4)	1.00		
<b>Education level</b>					
None	13	3 (23.1)	0.45	0.12, 1.70	0.24
Primary	420	158 (37.6)	0.91	0.63, 1.31	0.61
Secondary+	168	67 (39.9)	1.00		
<b>Marital status</b>					
Single	73	29 (39.7)	1.09	0.66, 1.80	0.80
Married/Cohabiting	487	184 (37.8)	1.00		
Divorced/ separated/ widowed	39	14 (35.9)	0.92	0.45, 1.74	0.82
<b>Occupation</b>					
Peasant/farmer	366	127 (34.7)	0.72	0.49, 1.05	0.09
Employed	160	68 (42.5)	1.00		
Others	38	21 (55.3)	1.67	0.82, 3.41	0.16
<b>Body mass index categories</b>					
Normal	285	116 (40.7)	1.00		
Underweight	26	10 (38.5)	0.91	0.40, 2.08	0.82
Overweight	199	69 (34.7)	0.77	0.53, 1.13	0.18
Obese	85	32 (37.7)	0.88	0.53, 1.45	0.61
<b>Consume alcohol</b>					
No	367	152 (41.4)	1.00		
Yes	235	76 (32.3)	0.68	0.48, 0.95	<b>0.03</b>
<b>Number of ANC visits</b>					
≥4	382	148 (38.7)	1.00		
<4	199	73 (36.7)	0.92	0.64, 1.31	0.63
<b>Child given deworming drugs</b>					
No	171	72 (42.1)			
Yes	408	150 (36.8)	0.80	0.56, 1.15	0.23
<b>Baby given colostrum</b>					
No	22	10 (45.5)	1.00		
Yes	576	215 (37.3)	0.71	0.30, 1.68	0.44
<b>Meal frequency per day</b>					
≤3	321	118 (36.7)	1.00		
>3	265	105 (39.6)	1.13	0.81, 1.58	0.48
<b>Age at complementary feeding</b>					
<6 months	375	137 (36.5)	1.00		
≥6 months	163	71 (43.6)	1.34	0.92, 1.95	0.13

Variables	N	Anemic (%)	COR*	95% CI	p-value
<b>Child exclusively breastfed</b>					
No	349	120 (34.4)	1.00		
Yes	234	104 (44.4)	1.53	1.09, 2.14	<b>0.02</b>
<b>Wasted</b>					
No	542	207 (38.2)	1.00		
Yes	60	21 (35.0)	0.87	0.50, 1.52	0.63
<b>Stunted</b>					
No	370	129 (34.8)	1.00		
Yes	232	99 (42.7)	1.39	0.99, 1.95	0.06
<b>Underweight</b>					
No	566	217 (38.3)	1.00		
Yes	36	11 (30.6)	0.71	0.34, 1.47	0.35
<b>Sex of the child</b>					
Male	317	115 (36.2)	1.00		
Female	285	113 (39.7)	1.15	0.83, 1.61	0.40
<b>Child age categories</b>					
6–23	286	138 (48.1)	2.34	1.67, 3.28	<b>&lt;0.001</b>
24–59	316	90 (28.5)	1.00		

\*COR=Crude odds ratio

There were no significant differences in the prevalence of anemia by sex of the child in this study which is consistent with findings from other studies<sup>13,14,18,30</sup>. On the contrary, females have been reported to be less likely to be anemic in Ethiopia<sup>16</sup>, which is contrary to findings from Kenya where the risk was high in male children (aged 6 months to 14 years)<sup>31</sup>, which could account for these differences. We did not find an association between maternal characteristics such as age categories, education level, occupation and ANC visits among others contrary to other studies. ANC visit and mother's occupation have been associated with anemia elsewhere<sup>7,16</sup>. The higher education level of mothers is protective against childhood anemia<sup>15,19,31</sup>.

Likewise, there was no association between nutritional characteristics such as deworming drugs uptake, exclusive breastfeeding (EBF), colostrum feeding, complementary feeding, and feeding frequency with anemia. However, other studies reported an association between nutritional characteristics with a higher risk of anemia in under-five children<sup>4,5,14,18,33</sup>. On the contrary, Meinzen-Derr *et al.*<sup>20</sup> reported that, infants exclusively breastfed for six months in developing countries might be at increased risk of anemia, especially among mothers with poor iron status. In addition, there is evidence that the longer the infant is exclusively breastfed, the worse the severity of childhood anemia due to low iron content in breast milk<sup>35,36</sup>. The positive association between EBF and anemia was

observed in this study but was not statistically significant. The effect of EBF on anemia in children is an area that needs further research. Despite the observed association in this study, nutritional interventions (EBF included) are among the key strategies to reduce the burden of anemia in under-five children<sup>21,23,27</sup>.

The study involved participants from most wards in the Rombo district, providing a picture of anemia in children under five. However, the findings in this study may not be generalized to other districts in Kilimanjaro and regions across the country. Also, the study might have been prone to recall and social desirability bias due to the self-reporting of nutritional practices associated with anemia. These may under or over-estimate these practices in the district.

## Conclusion

The prevalence of anemia was lower than the national and regional prevalence but it still constitutes a significant public health problem especially among children aged 6–23 months. There were no significant differences in anemia prevalence by sex of the child and any of the nutritional characteristics. The study recommends iron supplementation, food fortification, dietary diversification, and management of childhood illnesses interventions for mothers and children under two years. Future studies should apply mixed methods, including longitudinal

**Table 4. Adjusted analysis for factors associated with anemia in children under five (N=602).**

Variables	AOR*	95% CI	p-value
<b>Age categories of the mother in years</b>			
<20	0.71	0.27, 2.84	0.48
20–29	0.86	0.59, 1.24	0.42
30+	1.00		
<b>Consume alcohol</b>			
No	1.00		
Yes	0.70	0.48, 1.02	0.06
<b>Child exclusively breastfed</b>			
No	1.00		
Yes	1.38	0.97, 1.98	0.08
<b>Wasted</b>			
No	1.00		
Yes	0.86	0.43, 1.72	0.66
<b>Stunted</b>			
No	1.00		
Yes	1.40	0.97, 2.02	0.07
<b>Underweight</b>			
No	1.00		
Yes	0.99	0.39, 2.52	0.98
<b>Sex of the child</b>			
Male	1.00		
Female	1.01	0.71, 1.44	0.94
<b>Child age categories</b>			
6–23	2.47	1.73, 3.53	<0.001
24–59	1.00		

\*AOR: Adjusted odds Ratio

follow-up, to explore and determine the factors associated with anemia in children necessary to inform context-specific interventions.

### Data availability

#### Underlying data

Harvard Dataverse: Anaemia in children under five years of age in rural Tanzania. <https://doi.org/10.7910/DVN/KJMNID><sup>29</sup>

This project contains the following underlying data:

- anemiaU5\_rombo2016data.tab (Data on anaemia prevalence and associated factors among children under five years of age in the Rombo district, Kilimanjaro region, Northern Tanzania)

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

## Extended data

Figshare: Questionnaire: Nutritional status of children U5 years of age in Kilimanjaro Region, Northern Tanzania. <https://doi.org/10.6084/m9.figshare.12553844.v2><sup>26</sup>

This project contains the following extended data:

- Questionnaire - Nutritional status of children U5 years of age - English.pdf (Study questionnaire - English)
- Questionnaire - Nutritional status of children U5 years of age.pdf (Study questionnaire)

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

## Acknowledgements

We extend our profound appreciation to the Institute of Public Health, Department of Community Health of Kilimanjaro Christian Medical University College for providing the data used in this study. We also acknowledge all the study participants whose consent enabled this study to be successful.

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[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)

# Open Peer Review

Current Peer Review Status: ? ? ✓

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## Version 3

Reviewer Report 15 February 2023

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**Mala Ali Mapatano**

Kinshasa School of Public Health, University of Kinshasa, Kinshasa, Kinshasa, Congo

I am satisfied and approve the publication.

**Competing Interests:** No competing interests were disclosed.

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

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## Version 2

Reviewer Report 07 September 2022

<https://doi.org/10.5256/f1000research.78635.r146334>

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**Mala Ali Mapatano**

Kinshasa School of Public Health, University of Kinshasa, Kinshasa, Kinshasa, Congo

**Title:** the methodology and results sections specify that the study focuses on children 6-59 months old. The title should reflect the same age category.

**Results:**

- The study shows no association with *exclusive breastfeeding, colostrum feeding*. These two variables are not appropriate in this context, since the methodology section limits the study

to children 6-59 months.

**Discussion:**

- The authors don't discuss thoroughly the differences between their findings and the literature:

For example:

1. *Age of the child was the only factor significantly associated with anemia among children. What could have been the confounding factors?*
2. *High prevalence in other studies could be linked to differences in the study population and wider population coverage since most utilized nationally representative data such as DHS data. What are these differences?*
3. After the statement of high prevalence in other studies, one would expect that the authors would cite those studies. Instead, they mention Ayoya et al. and Pita et al whose findings do not reflect high prevalence of anemia.

**References:**

Reference 2: is related to the Tanzania DHS, not to a WHO report. Therefore, the DHS is not the primary source of the definition of anemia, but only used it.

Reference 3: This policy brief focuses on women of reproductive age, not on children 6-59 months of age. It may not be relevant here. In fact, it refers to the general WHO definition of anemia, without even indicating the cut-off points.

**Is the work clearly and accurately presented and does it cite the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Nutritionist; epidemiologist

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 27 Dec 2022

**Innocent Mboya**, Kilimanjaro Christian Medical University College, Moshi, Tanzania

Dear Mala Ali Mapatano,  
We thank you for taking the time to review our manuscript. Below are clarifications and responses to your comments.

**Title:** the methodology and results sections specify that the study focuses on children 6-59 months old. The title should reflect the same age category.

Response: We thank the reviewer for this comment. However, we would like the title to be stated the same way because children 6-59 months still constitute the under-five-year category. Indeed, previous studies stated the same way even though their target population was children 6-59 months [1].

**Results:**

- The study shows no association with *exclusive breastfeeding, colostrum feeding*. These two variables are not appropriate in this context, since the methodology section limits the study to children 6-59 months.

Response: Previous studies established an association between exclusive breastfeeding with anemia in children 0-6 months. Women in this study were asked whether they breastfed the child exclusively for six months (regardless of the child's current age), the responses being Yes/No, but no association was observed with anemia. As indicated in the last but one paragraph of our discussion, more studies are necessary to establish a cause-effect relationship between exclusive breastfeeding and the risk of anemia in children. Nevertheless, there is evidence that the longer the infant is exclusively breastfed, the worse the severity of childhood anemia due to low iron content in breast milk [2, 3]. We have also added this information in the discussion section.

**Discussion:**

- The authors don't discuss thoroughly the differences between their findings and the literature:

For example:

1. Age of the child was the only factor significantly associated with anemia among children. What could have been the confounding factors?

Response: Several analyses were performed to determine the factors associated with anemia among children 6-59 months in this study. Details are also contained in the data analysis section. Age was the only statistically significant predictor of anemia even after adjusting for background and nutritional characteristics. We have added this description in the discussion section.



2. *High prevalence in other studies could be linked to differences in the study population and wider population coverage since most utilized nationally representative data such as DHS data. What are these differences?*

Response: By differences here we refer to the methodological variations in the included population. Cross-sectional surveys in a small geographical area are likely to give a slight difference estimate compared to the nationally representative sample such as the DHS. The first paragraph of the discussion section specifically highlights these issues.

3. After the statement of high prevalence in other studies, one would expect that the authors would cite those studies. Instead, they mention Ayoya et al. and Pita et al whose findings do not reflect high prevalence of anemia.

Response: Those studies are cited just before this statement. The sentence citing Ayoya et al is slightly edited for clarity.

#### **References:**

Reference 2: is related to the Tanzania DHS, not to a WHO report. Therefore, the DHS is not the primary source of the definition of anemia, but only used it.

Response: Reference 2 is the Tanzania Demographic and Health Survey report of 2015/16 and it contains the cited information. These anthropometric measurements were also assessed following a similar methodology documented in this report. In addition, reference 1 cites the WHO document defining anemia in children 6-59 months.

Reference 3: This policy brief focuses on women of reproductive age, not on children 6-59 months of age. It may not be relevant here. In fact, it refers to the general WHO definition of anemia, without even indicating the cut-off points.

Response: We have removed this citation of the definition of anemia in children under five.

#### **References**

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**Competing Interests:** None

Reviewer Report 17 February 2022

<https://doi.org/10.5256/f1000research.78635.r120374>

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### Indrapal I Meshram

Division of Public Health Nutrition, National Institute of Nutrition, Hyderabad, Telangana, India

- In method: Under study design, it is mentioned that the study aimed to assess the nutritional status of children under five years in the district. but in abstract, only anemia prevalence is mentioned and also title does not reflect this under study population, it is still not clear how many wards were selected and why systematic sampling was used for selection of HHs.
- Under study variable, para 3, it is mentioned reference 2 for WHO reference population, but reference 2 is not WHO reference.
- Under statistical analysis, nothing is mentioned about how nutritional status was decided.
- In table 1, single mother is mentioned, how single mother has child, it may be separated/divorcee or widow, this classification whether used in Africa the prevalence of underweight mentioned is 6% and wasting 10%, I still have some doubt about this percent as stunting is 38%. While considering reference in logistic regression, always we consider good practices as reference, but this is not followed in this table. Age at Complementary feeding should be below 6 months, 6-8 months and after 8 months and likely analysis should be done.

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Public Health Nutrition

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 25 Nov 2022

**Innocent Mboya**, Kilimanjaro Christian Medical University College, Moshi, Tanzania

Dear Dr. Indrapal I Meshram,  
We thank you for your time in reviewing this manuscript. Please find below our responses to your recent comments with detailed clarifications.

In method: Under study design, it is mentioned that the study aimed to assess the nutritional status of children under five years in the district. but in abstract, only anemia prevalence is mentioned and also title does not reflect this under study population, it is still not clear how many wards were selected and why systematic sampling was used for selection of HHs.

**Response:** *The current study used secondary data from a community-based cross-sectional study conducted in the district whose primary purpose was to assess the nutritional status of children under five years of age. Our analysis focused primarily on anemia and its associated factors given the high burden of this problem in the region and Tanzania in general.*

Under study variable, para 3, it is mentioned reference 2 for WHO reference population, but reference 2 is not WHO reference.

**Response:** *We acknowledge the reviewer's comment. Please note that reference 2 is the Tanzania Demographic and Health Survey report of 2015/16 and it contains the cited information. These anthropometric measurements were also assessed following a similar methodology documented in this report.*

Under statistical analysis, nothing is mentioned about how nutritional status was decided.

**Response:** *We have this information at the end of paragraph 3 of the study variables section which reads; "Child anthropometric z-scores were calculated using the 2006 WHO child growth standards through the "zscore06" package in Stata". This function in Stata software allows the specification of the child's height, weight, age, and sex among other parameters for the calculation of z-scores.*

In table 1, single mother is mentioned, how single mother has child, it may be separated/divorcee or widow, this classification whether used in Africa the prevalence of underweight mentioned is 6% and wasting 10%, I still have some doubt about this percent

as stunting is 38%. While considering reference in logistic regression, always we consider good practices as reference, but this is not followed in this table. Age at Complementary feeding should be below 6 month, 6-8 months and after 8 months and likely analysis should be done.

**Responses:**

- *Regarding marital status, it is possible for a single mother to have a child even without being married. The reason is a woman may choose to have children without any marital commitment. This classification is not specific in African settings. Existing literature documents different socio-cultural, economic, and health issues experienced by single mothers. The contextual definition of single motherhood may differ depending on the area of application. Some examples are illustrated in these two sources, one which is specific to Tanzania [1, 2].*
- *Regarding the reported results on the anthropometric measures (i.e., wasting, stunting, and underweight), we would like to indicate that our results are consistent with the Tanzania Demographic and Health Survey of 2015/16 [3]. The first paragraph of the discussion section compares the observed results.*
- *Regarding Age at complementary feeding, we want to acknowledge the reviewer comment. However, the reason for having two groups ( $< 6$  months and  $\geq 6$  months) as shown in Table 2 and 3 is to gain more statistical power as a function of sample size. It can be seen in Table 2 that there were 163 (30.3%) children initiated complementary feeding at  $\geq 6$  months. Breaking this variable further will not improve the results observed in Table 3 and may increase the probability of committing type I error [4].*

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**Competing Interests:** None

**Version 1**

Reviewer Report 08 October 2021

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**Tania Supali**

Department of Parasitology, Universitas Indonesia, Jakarta, Indonesia

It is difficult to review the manuscript because the format of manuscript is not in one column with line numbering.

- **Introduction:** needs to be rewritten properly
- **Methods:**
  - It should be written systematically. Example: Data collection for Hb measurement (anemia) should be separated from collecting questionnaire data.
  - The rural and urban study areas were not described in detail. There are 27 children from urban and 575 children from rural (Table 1). What is the definition of urban and rural?
  - Why was the number of urban children only 27 children?
- **Results:**
  - Prevalence of anemia based on age and sex – can be combined in one table.
  - Table 1 and 3 can be combined in one table.
  - Please rewrite the results systematically
- **Discussion:**
  - It is unclear why children below 2 years old showed high prevalence of anemia compared to 24-59 months children. Please explain in more details.
  - A question about deworming drugs was included in the questionnaire. What was the prevalence of STH in the study area? The impact of intestinal helminth infection should be discussed in this manuscript.
  - Malaria is prevalent in Tanzania. Why wasn't malaria data included in the study, given that it contributes to anemia?

In general: The manuscript needs major revision.

**Is the work clearly and accurately presented and does it cite the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Parasitology

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 20 Oct 2021

**Innocent Mboya**, Kilimanjaro Christian Medical University College, Moshi, Tanzania

Dear Supali,

Thank you for your time to review this manuscript. We have addressed your comments and suggestions as detailed below.

- *Introduction: needs to be rewritten properly*
- **Response:** The introduction has been revised accordingly.
  
- *Methods: It should be written systematically. Example: Data collection for Hb measurement (anemia) should be separated from collecting questionnaire data.*
- **Response:** Information about Hb and other measurements has been shifted to the study variables and measurements section.
  
- *The rural and urban study areas were not described in detail. There are 27 children from urban and 575 children from rural (Table 1). What is the definition of urban and rural?*
- **Response:** As also responded to the first reviewer, Rombo is considered a rural district of Kilimanjaro region. However, participants were asked whether they considered the place of their residence as urban or rural. Those who resided in urban areas were mostly from the district's centre (mostly referred by locals as urban or town). The key services such as the district's commissioner's office/headquarter,

district hospital, among others are in this setting. In addition, wards are largest administrative units and contains several villages.

- *Why was the number of urban children only 27 children?*
- **Response:** Please see the response above.
  
- *Results: Prevalence of anemia based on age and sex – can be combined in one table.*
- **Response:** The reviewer response is acknowledged. The figures are much preferred against tables for better presentation and for the capturing the reader's interest. This is also supported by the observed findings in this study where anemia prevalence differed significantly by child's age groups.
  
- *Table 1 and 3 can be combined in one table.*
- **Response:** Tables 1 and 2 focuses on describing the participant background and nutritional characteristics. Table 3 contains slightly different information. It compares the prevalence of anemia by these characteristics and provides results from the crude regression analysis. For these reasons, we would like to retain the current table structure.
  
- *Please rewrite the results systematically*
- **Response:** The results section has been revised accordingly.
  
- *Discussion: It is unclear why children below 2 years old showed high prevalence of anemia compared to 24-59 months children. Please explain in more details.*
- **Response:** The reviewer comment is acknowledged. The first and second paragraphs of the discussion section has been revised to clearly explain the observed results, which also compare with previous studies and shows the public health implications.
  
- *A question about deworming drugs was included in the questionnaire. What was the prevalence of STH in the study area? The impact of intestinal helminth infection should be discussed in this manuscript.*
- **Response:** Unfortunately, the study did not assess the prevalence of STH which may be associated with increased anemia risk, which remains an area for future studies.
  
- *Malaria is prevalent in Tanzania. Why wasn't malaria data included in the study, given that it contributes to anemia?*
- **Response:** We thank the reviewer for this comment. Although malaria is prevalent in Tanzania, not all regions are highly affected. At the regional level, malaria prevalence is high in the Southern slopes of Mount Kilimanjaro compared to the highlands[1]. Secondly, the primary study aim was to assess prevalence of anemia in children under five in the Rombo district. A more comprehensive study that capture the social-economic, demographic, behavioral, and clinical determinants of anemia and other child nutritional-related characteristics is essential in this setting.
  
- *In general: The manuscript needs major revision.*

- **Response:** The manuscript has been revised accordingly.

[1] Kassam, N. A., Kaaya, R. D., Damian, D. J., Schmiegelow, C., Kavishe, R. A., Alifrangis, M., & Wang, C. W. (2021). Ten years of monitoring malaria trend and factors associated with malaria test positivity rates in Lower Moshi. *Malaria Journal*, 20(1), 1-9.

**Competing Interests:** No competing interests were disclosed.

Reviewer Report 17 May 2021

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## Indrapal I Meshram

Division of Public Health Nutrition, National Institute of Nutrition, Hyderabad, Telangana, India

### Introduction

1. Globally, about 43% of children under-five are anemic, and **there is a marked variation in the prevalence of anemia between low and middle-income countries**. Over 50% of anemic children live in low- and middle-income countries
2. **There is also a variation in anemia prevalence within low- and middle-income countries**; Repetition of sentence

### Under study design and setting

1. No need to give district profile, better to shift under introduction.
2. Villages were randomly selected from a random sample of wards. I think the study was done in both urban and rural areas, so while using, use both village/wards.
3. How many villages and how many children from each villages/wards were selected is not clear. Also author has mentioned that the survey was done in villages, then wards also mentioned, is it a rural ward or urban, whether urban/rural children were selected is not clear. If so, how these children were selected from urban and rural areas were selected need to be mentioned.
4. Proportionate sampling should be done in order to give equal representation.

### Under Study population, sample size and sampling-

1. It is mentioned that children whose mothers were not available on the day of data collection were excluded from the study as it was not possible to verify child information if next in kin or neighbor was interviewed. But in next para, it is mentioned that If the child's mother was not at home, the research team visited the house for a minimum of three times before declaring that the participant could not be reached. This is not matching with above statement.
2. Ethical para should be written before analysis.



3. Why underweight prevalence is not given when weight has been measured.
4. In table 1, age of child mentioned is 6-26, pl correct 6-23.
5. Table 2, Time at complementary feeding, correct as age at CF.
6. While selecting reference category, positive variable should be consider as reference.
7. Adjusted analysis, which variables were adjusted in regression is not clear, which variable was removed first should be mentioned.

#### **Under discussion**

1. Prevalence in this study is similar to 38.8% among under-five children in Haiti, but higher than 26% in Cuba. The low prevalence in Cuba was associated to food-fortification interventions among other strategies.
2. Sentence need to rewrite properly such as study by ----- observed 39% prevalence of anemia among under 5 year children in Haiti, while study by ----- observed lower (26%) prevalence of anemia in Cuba which may be due to food fortification being implemented among this study population. This practice could be one of the factors that leads to poor anemia status in children, sentence is not correct it is not poor anemia status but low hemoglobin levels.
3. Mothers of children aged 6–11 months in Australia did not receive quality anemia care, particularly nutrition advice about healthy foods and the minimum acceptable diet to the care givers- this should not be mentioned here as this study is not in Australia.
4. The high prevalence of anemia among infants in this study is of concern. Interventions such as iron supplementation, food fortification and dietary diversification and management of childhood illnesses in this setting should be targeted towards mothers and children less than two years. There were no significant differences in the prevalence of anemia by sex of the child in this study which is consistent to findings from other studies- there is no continuity of statement first sentence should deleted as it is there in last para.
5. Sentence writing needs to be changed, should take help from English speaking person who can write fluently.
6. From the study, no other factors except age of child was observed significant, other factors such as type of house, drinking water facility sanitary latrine, morbidities in previous fortnight or one months if studied would have given more information, no new information /variable has been found or studied.

#### **Under conclusion**

1. Children in this age group were more likely to be anemic compared to those aged 24–59 months-this is of no use in this para first sentence itself is explanatory. In conclusion one has to mention that there is a need to explore other factors contributing to anemia as IFS supplementation, morbidities during previous fortnight, sanitary latrine use and mothers hemoglobin status. In recommendation, it is mentioned IFA supplementation, but whether these children were supplemented IFA has not been studied although this is universal

program. So recommendation should also be based on the finding of the study.

2. Spelling of complementary feeding should be checked.

**In general**

1. Discussion needs to be rewritten properly with continuity of sentence.

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Public Health Nutrition

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Author Response 20 Oct 2021

**Innocent Mboya**, Kilimanjaro Christian Medical University College, Moshi, Tanzania

Dear Meshram,

Thank you for taking time to review our manuscripts. The manuscript has been revised based on your suggestions as explained below.

**Comments:**

- *Introduction: Globally, about 43% of children under-five are anemic, and there is a marked variation in the prevalence of anemia between low and middle-income countries. Over 50% of anemic children live in low- and middle-income countries 12. There is also a variation in anemia prevalence within low- and middle-income countries; Repetition of sentence*
- **Response:** The paragraph has been revised to avoid repetitions.

- *Under study design and setting: No need to give district profile, better to shift under introduction.*
- **Response:** The district profile is briefly discussed here to give a reader the context with respect to setting where the study was conducted. The background section focused on describing the problem given the current literature and showing the gap that necessitated the conduct of this study. For this reason, the district profile fits best in the methods section than in the introduction. The text has been slightly revised to avoid repetitions.
  
- *Villages were randomly selected from a random sample of wards. I think the study was done in both urban and rural areas, so while using, use both village/wards.*
- **Response:** Rombo is considered a rural district of Kilimanjaro region. However, participants were asked whether they considered the place of their residence as urban or rural. Those who resided in urban areas were mostly from the district's centre (mostly referred by locals as urban or town). The key services such as the district's commissioner's office/headquarter, district hospital, among others are in this setting. In addition, wards are largest administrative units and contains several villages.
  
- *How many villages and how many children from each villages/wards were selected is not clear. Also author has mentioned that the survey was done in villages, then wards also mentioned, is it a rural ward or urban, whether urban/rural children were selected is not clear. If so, how these children were selected from urban and rural areas were selected need to be mentioned.*
- **Response:** Two villages were randomly selected from a random sample of wards. Also, a systematic random sampling was used to select households. Changes have been made to in the study population, sample size and sampling to make this more specific and clearer. Regarding urban vs rural, please see the response above.
  
- *Proportionate sampling should be done in order to give equal representation.*
- **Response:** More than half of all wards in the district were included in this study. For this reason, data from this study are representative of the district population. However, the findings from this study may not be generalized to other districts in Kilimanjaro region and the entire country. This has been added in the last paragraph of the discussion section detailing the study strengths and limitations.
  
- *Under Study population, sample size and sampling - It is mentioned that children whose mothers were not available on the day of data collection were excluded from the study as it was not possible to verify child information if next in kin or neighbor was interviewed. But in next para, it is mentioned that If the child's mother was not at home, the research team visited the house for a minimum of three times before declaring that the participant could not be reached. This is not matching with above statement.*
- **Response:** The reviewer comment is acknowledged. The paragraph has been revised to merge and link this information.
  
- *Ethical para should be written before analysis.*

- **Response:** The ethics paragraph has been repositioned.
- *Why underweight prevalence is not given when weight has been measured.*
- **Response:** Underweight results has been included in the descriptive statistics.
- *In table 1, age of child mentioned is 6-26, pl correct 6-23.*
- **Response:** Child age categories has been corrected in Table 1.
- *Table 2, Time at complementary feeding, correct as age at CF.*
- **Response:** Time at complementary feeding changed to Age at complementary feeding in Age 2 and 3.
- *While selecting reference category, positive variable should be consider as reference.*
- **Response:** We thank the reviewer for this comment. The initial analysis considered the positive category as the reference.
- *Adjusted analysis, which variables were adjusted in regression is not clear, which variable was removed first should be mentioned.*
- **Response:** Stepwise regression method was used to select variables to include in the adjusted analysis at 10% threshold level. Age of the child remained the only significant predictor of anemia at this stage. Maternal age, alcohol use (statistically significant in the crude analysis), sex of the child, and child's nutritional characteristics, specifically exclusive breastfeeding, wasting, and stunting were considered potential confounders, hence included in the final model. This information has been added in the data analysis section.
- *Under discussion: Prevalence in this study is similar to 38.8% among under-five children in Haiti, but higher than 26% in Cuba. The low prevalence in Cuba was associated to food-fortification interventions among other strategies. Sentence need to rewrite properly such as study by ----- observed 39% prevalence of anemia among under 5 year children in Haiti, while study by ----- observed lower (26%) prevalence of anemia in Cuba which may be due to food fortification being implemented among this study population.*
- **Response:** The sentences have been revised accordingly.
- *This practice could be one of the factors that leads to poor anemia status in children, sentence is not correct it is not poor anemia status but low hemoglobin levels.*
- **Response:** The sentence has been corrected.
- *Mothers of children aged 6–11 months in Australia did not receive quality anemia care, particularly nutrition advice about healthy foods and the minimum acceptable diet to the care givers- this should not be mentioned here as this study is not in Australia.*
- **Response:** The sentence has been revised and included the recommended best practices from this study.
- *The high prevalence of anemia among infants in this study is of concern. Interventions such as iron supplementation, food fortification and dietary diversification and*

*management of childhood illnesses in this setting should be targeted towards mothers and children less than two years. There were no significant differences in the prevalence of anemia by sex of the child in this study which is consistent to findings from other studies- there is no continuity of statement first sentence should be deleted as it is there in last para.*

- **Response:** The first two sentences have been deleted to ensure continuity of sentences in this paragraph.
  
- *Sentence writing needs to be changed, should take help from English speaking person who can write fluently.*
- **Response:** The manuscript has been revised to correct for grammatical errors and structure of sentences.
  
- *From the study, no other factors except age of child was observed significant, other factors such as type of house, drinking water facility sanitary latrine, morbidities in previous fortnight or one month if studied would have given more information, no new information /variable has been found or studied.*
- **Response:** The reviewer comment is acknowledged. Determinants of anemia are multi-factorial and are likely to differ across settings. The discussion section has also highlighted numerous other factors that were analysed but had no significant statistical association with anemia in children. Qualitative and quantitative studies, especially the methods employing longitudinal measurements may be relevant in this context to determine the factors associated with anemia in children to inform interventions. This recommendation has been added in the conclusion paragraph.
  
- *Under conclusion: Children in this age group were more likely to be anemic compared to those aged 24–59 months-this is of no use in this para first sentence itself is explanatory. In conclusion one has to mention that there is a need to explore other factors contributing to anemia as IFS supplementation, morbidities during previous fortnight, sanitary latrine use and mothers hemoglobin status. In recommendation, it is mentioned IFA supplementation, but whether these children were supplemented IFA has not been studied although this is universal program. So recommendation should also be based on the finding of the study.*
- **Response:** The recommendation has been added as suggested.
  
- *Spelling of complementary feeding should be checked.*
- **Response:** The spelling errors have been checked and corrected.
  
- *In general: Discussion needs to be rewritten properly with continuity of sentence.*
- **Response:** The discussion section has been revised based also on the reviewer suggestions.

**Competing Interests:** No competing interests were disclosed.

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