RESEARCH ARTICLE

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

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v1 **First published:** 07 Sep 2020, **9**:1102
https://doi.org/10.12688/f1000research.24707.1
Second version: 19 Jan 2022, **9**:1102
https://doi.org/10.12688/f1000research.24707.2
Latest published: 02 Feb 2023, **9**:1102
https://doi.org/10.12688/f1000research.24707.3

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. We aimed to determine the prevalence and factors associated with anemia among children under five years of age in northern Tanzania.

Methods: This was a community-based cross-sectional study 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 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=2.44, 95% CI 1.71, 3.49, 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.

Open Peer Review

Approval Status ? ? ✓

	1	2	3
version 3 (revision) 02 Feb 2023			✓ view
version 2 (revision) 19 Jan 2022	? view		? view
version 1 07 Sep 2020	? view	? view	

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Any reports and responses or comments on the

Conclusion: 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. 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.

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

article can be found at the end of the article.

This article is included in the Sociology of Health gateway.

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Author roles: Mboya IB: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Mamseri R**: Conceptualization, Investigation, Methodology, Project Administration, Supervision, Validation, Visualization, Writing – Review & Editing; **Leyaro BJ**: Conceptualization, Data Curation, Investigation, Methodology, Project Administration, Supervision, Validation, Writing – Review & Editing; **George J**: Conceptualization, Investigation, Methodology, Project Administration, Supervision, Validation, Writing – Review & Editing; **Msuya SE**: Conceptualization, Investigation, Methodology, Project Administration, Supervision, Validation, Writing – Review & Editing; **Mgongo M**: Conceptualization, Investigation, Methodology, Project Administration, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

How to cite this article: Mboya IB, Mamseri R, Leyaro BJ *et al.* **Prevalence and factors associated with anemia among children under five years of age in Rombo district, Kilimanjaro region, Northern Tanzania [version 1; peer review: 2 approved with reservations]** F1000Research 2020, **9**:1102 https://doi.org/10.12688/f1000research.24707.1

First published: 07 Sep 2020, **9**:1102 https://doi.org/10.12688/f1000research.24707.1

Introduction

Anemia in children under five years is a significant public health problem in 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[1–3]. 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[2–11]. 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; the highest rate (78%) reported in Ghana and the lowest (26%) in Cuba[13,14]. According to WHO report, Africa region is reported to have the highest proportion (62%) of children who are anemic[12].

A variety of factors causes anemia, but the most common cause is iron deficiency[1,3,12]. Iron deficiency can result from inadequate dietary intake of iron or poor absorption, increased needs for iron during the high growth periods and increase iron loses due to helminths infection[3]. Other causes of anemia can be due to infections like malaria, genetic makeup and nutritional deficiencies of vitamins B12, A, C and folate[3]. Factors reported being associated with anemia also vary from region to region. The factors include area of residence whereby children living in rural areas are reported to be 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[1,4,13–20]. Unemployment, low family income, low wealth quartile and high poverty index has also been associated with anemia in children under five[5,9,15,17]. In addition, poor breastfeeding practices and complementary feeding leads to anemia[7,14–16].

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[21]. 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 programs[21]. Improved quality of anemia care is also among key strategies to accelerate progress towards addressing this problem[22]. Although Tanzania is implementing these strategies[23], Demographic and Health Survey (DHS) report shows that there is 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 Kilimanjaro region, Same District, anemia prevalence was reported to be 70%[19]. Since studies show variations in factors that are associated with anemia, there was a need to conduct this study in 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 Kilimanjaro region which is located on the north-eastern part of the 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[24]. The largest population of the district depends on agriculture, livestock keeping and small petty business and few people are employed in the public sector. The district has 43 health facilities; 2 hospitals, 4 health centers and 37 dispensaries[25].

Study population, sample size and sampling

The study included consenting mothers and their children aged 6–59 months. 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. We also excluded children with missing information on hemoglobin concentrations. 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[2], 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. Villages were randomly selected from a random sample of wards. A listing of households with children under five years was generated with the help of ward/village and street leaders or link persons, followed by a random selection of 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 for a minimum of three times before declaring that the participant could not be reached. After excluding 89 children aged <6 months, 17 children missing hemoglobin concentrations; we analyzed data for 602 mothers-child pairs Figure 1.

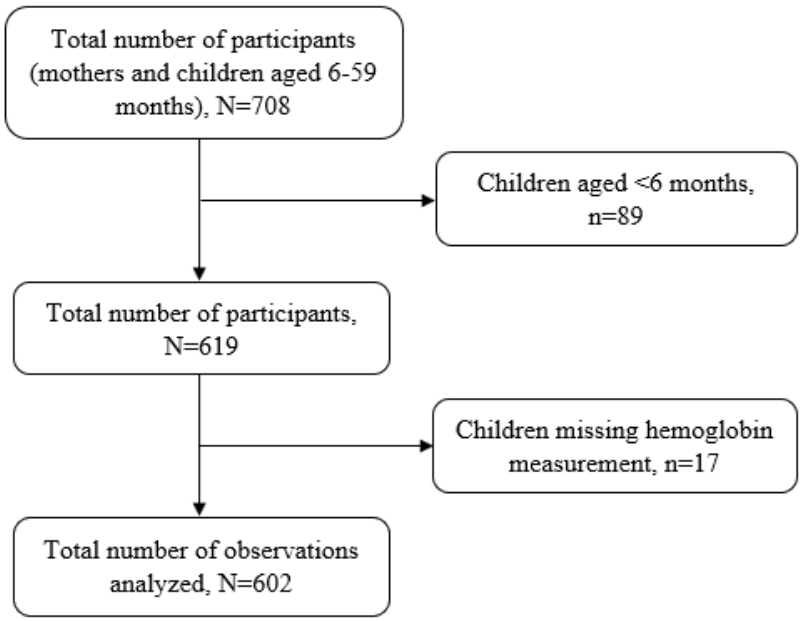

Figure 1. Schematic diagram showing the number of participants.

Data collection

A questionnaire, shared as an extended data[26], was used to collect data during face to face interviews. Although the questionnaire has not been validated in Tanzania, we adopted questions from the demographic and health survey and added some from previous literature. The following information was collected; maternal reproductive health, breastfeeding history, feeding patterns, initiation of complementary feeding, use of health facilities during pregnancy and anthropometric measurements. 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. 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. Data collection was done by trained medical student at the Kilimanjaro Christian Medical University College under the supervision of the Institute of Public Health.

Study variables

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[1]. 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), BMI of the mother (underweight (<18.5Kg/m^2), normal weight (18.5–24.9 Kg/m^2), overweight (25–29.9 Kg/m^2) and obese (≥30 Kg/m^2)) and age and sex of the child. Nutritional characteristics included exclusive breastfeeding (Yes and No)[27], colostrum feeding (Yes and No), meal frequency per day (≤3 meals and >3 meals), time at initiation of complimentary feeding (<6 months and 6+ months), use of deworming drugs past six months (Yes and No), stunting and wasting (height-for-age and weight-for-height z-score below minus two standard deviations (-2 SD) from the median of the WHO reference population[2]. Child anthropometric z-scores were calculated using the 2006 WHO child growth standards through the "zscore06" package in Stata[28].

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 (χ^2) test was used to compare 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. Robust variance estimator was used to account for model misspecification hence improve precision of estimates.

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. Prior to data collection, logistics meetings were held with ward and village leaders of selected sites to inform them about the study purpose. Mothers were explained the purpose of the study before enrolment. Those who agreed to participant provided written informed consent. To ensure anonymity of participant information, unique identification numbers were used.

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. 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[29].

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 while 69.7% were initiated complimentary feeding before six months. Also, 70.5% of children in this study were given deworming drugs. Prevalence of wasting and stunting in this study was 10% and 38.5%, respectively Table 2[29].

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

Variables	Frequency	Percentage
Age categories of the mother in years*		
Mean (SD)	29.9 (7.6)	
<20	19	3.2
20–29	307	52.0
30+	264	44.8
Education level*		
None	13	2.2
Primary	420	69.9
Secondary and above	168	28.0
Marital status*		
Single	73	12.2
Married/Cohabiting	487	81.3
Divorced/ separated/ widowed	39	6.5
Occupation*		
Peasant/farmer	366	64.9
Employed	160	28.3
Others	38	6.7
Area of residence		
Urban	27	4.5
Rural	575	95.5
Body mass index categories*		
Normal	285	47.9
Underweight	26	4.4
Overweight	199	33.4
Obese	85	14.3

Variables	Frequency	Percentage
Consume alcohol		
No	367	60.9
Yes	235	39.0
Attended ANC during pregnancy for this baby*		
No	13	2.2
Yes	585	97.8
Number of ANC visits* (n=585)		
≥4	382	65.8
<4	199	34.2
Sex of the child		
Male	317	52.7
Female	285	47.3
Age of the child (months)		
Median (IQR)	24 (14, 36)	
6–26	286	47.5
24–59	316	52.5

*Variable with missing information.

Table 2. Nutritional characteristics (N=602).

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

*Variable with missing information

Prevalence of anemia by child's age and sex

The mean (SD) hemoglobin level of children aged 6–59 months in this study was 11.2±1.6g/dl while 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[29], 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[29]. This differences in the prevalence by age was statistically significant (p<0.001).

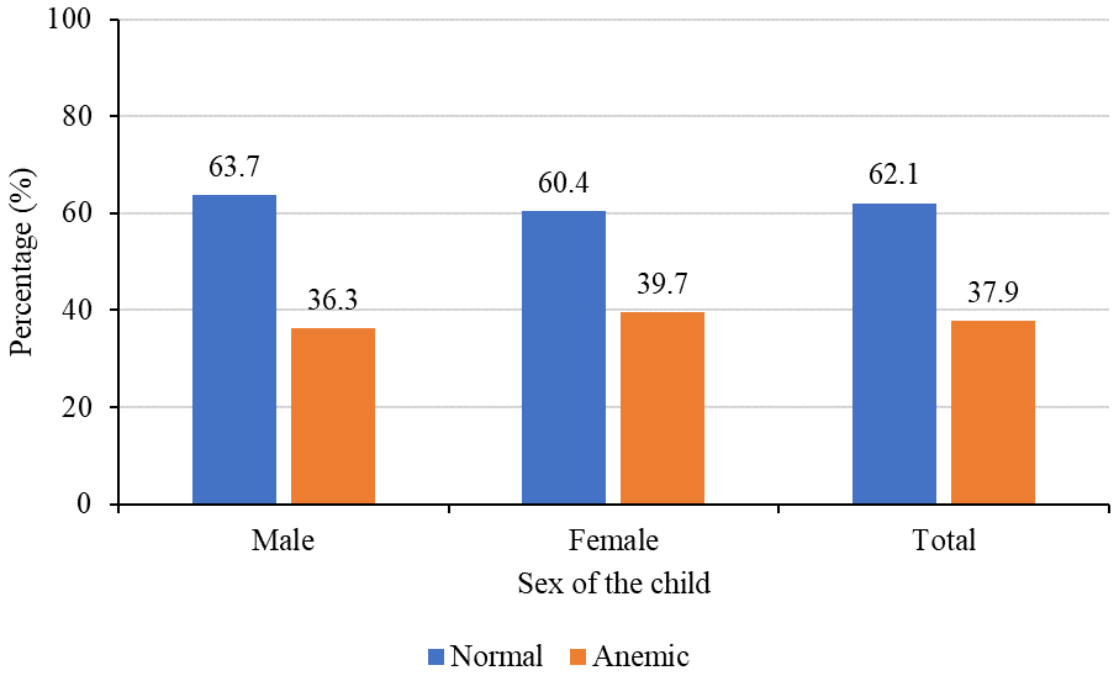

Figure 2. Prevalence of anemia by sex of the child (N=602).

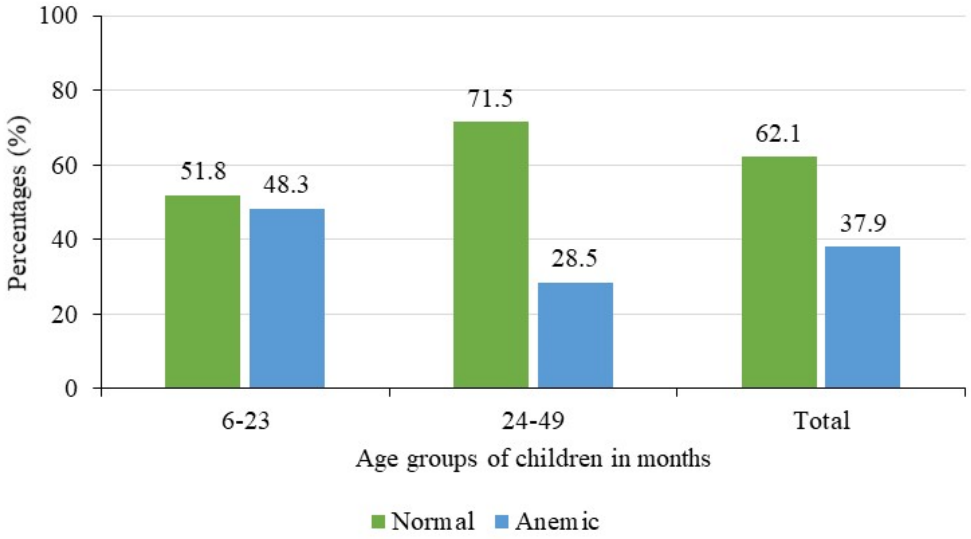

Figure 3. Prevalence of anemia by age groups of children in months (N=602).

Factors associated with anemia

We performed crude and adjusted analysis to determine factors associated with anemia in children aged 6–59 months in this study. In the crude analysis, factors associated with anemia were whether the mother consumed alcohol, exclusive breastfeeding and child's age Table 3[29]. 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[29].

Adjusted analysis for factors associated with anemia in children are shown in Table 4[29]. A multivariable model was developed by adding and later removing one variable after another to

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

Variables	N	Anemic (%)	COR*	95% CI	p-value
Age categories of the mother in years					
<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		
Education level					
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		
Marital status					
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
Occupation					
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
Body mass index categories					
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
Consume alcohol					
No	367	152 (41.4)	1.00		
Yes	235	76 (32.3)	0.68	0.48, 0.95	**0.03**
Number of ANC visits					
≥4	382	148 (38.7)	1.00		
<4	199	73 (36.7)	0.92	0.64, 1.31	0.63
Child given deworming drugs					
No	171	72 (42.1)			
Yes	408	150 (36.8)	0.80	0.56, 1.15	0.23
Baby given colostrum					
No	22	10 (45.5)	1.00		
Yes	576	215 (37.3)	0.71	0.30, 1.68	0.44
Meal frequency per day					
≤3	321	118 (36.7)	1.00		
>3	265	105 (39.6)	1.13	0.81, 1.58	0.48

Variables	N	Anemic (%)	COR*	95% CI	p-value
Time at complementary feeding					
<6 months	375	137 (36.5)	1.00		
≥6 months	163	71 (43.6)	1.34	0.92, 1.95	0.13
Child exclusively breastfed					
No	349	120 (34.4)	1.00		
Yes	234	104 (44.4)	1.53	1.09, 2.14	**0.02**
Wasted					
No	542	207 (38.2)	1.00		
Yes	60	21 (35.0)	0.87	0.50, 1.52	0.63
Stunted					
No	370	129 (34.8)	1.00		
Yes	232	99 (42.7)	1.39	0.99, 1.95	0.06
Sex of the child					
Male	317	115 (36.2)	1.00		
Female	285	113 (39.7)	1.15	0.83, 1.61	0.40
Child age categories					
6–23	286	138 (48.1)	2.34	1.67, 3.28	**<0.001**
24–59	316	90 (28.5)	1.00		

*COR=Crude odds ratio

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

Variables	AOR*	95% CI	p-value
Age categories of the mother in years			
<20	0.84	0.32, 2.19	0.72
20–29	0.84	0.58, 1.22	0.35
30+	1.00		
Consume alcohol			
No	1.00		
Yes	0.70	0.48, 1.02	0.06
Child exclusively breastfed			
No	1.00		
Yes	1.37	0.96, 1.97	0.08
Wasted			
No	1.00		
Yes	0.85	0.45, 1.61	0.62
Stunted			
No	1.00		
Yes	1.41	0.98, 2.03	0.06
Sex of the child			
Male	1.00		
Female	1.02	0.72, 1.45	0.91
Child age categories			
6–23	2.44	1.71, 3.49	<0.001
24–59	1.00		

*AOR: Adjusted odds Ratio

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, wasting, stunting and child's sex, children aged 6–23 months had over two times higher odds of being anemic (OR=2.44, 95%CI 1.71, 3.49) compared to those aged 24–59 months Table 4[29].

Discussion

Prevalence of anemia among children aged 6-59 months in this was 37.9%. Age of the child was the only factor significantly associated with anemia among children. Prevalence of anemia in this study is much lower compared to the national and regional estimates[2] and other sub-population studies in Tanzania[9,19]. One of these studies was hospital-based[9] while the other included children aged 1–35 months[19] that could explain the differences. Prevalence in this study is also lower that those reported in other countries[5,13,15,16,30]. High prevalence in other studies could be linked to differences in study population and wider population coverage since most of them utilized the nationally representative data such as DHS data. Prevalence in this study is similar to 38.8% among under-five children in Haiti[4] but higher than 26% in Cuba[14] although the study found a consistently higher prevalence among children aged 6–23 than 24–59 months. The low prevalence in Cuba was associated to food-fortification interventions among other strategies[14]. Despite the observed differences, prevalence reported in this study constitutes a significant public health problem[12] that needs intensified efforts.

Children aged 6–23 months had higher odds of having anemia compared to those aged 24–59 months in this study. Infants (<24 months) are consistently reported to be at higher odds of being anemic in other studies[2,4,5,13,14,31,32]. During this age, children have a higher demand for nutrients needed for their growth, hence are in need of 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[33]. This practice could be one of the factors that leads to poor anemia status in children[33,34]. Also, conflicting advice on infant and young child feeding from a range of sources, including close relatives, community members and health care providers affects breastfeeding practices, which has impact on the child's anemia status[34]. 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 giver, and hemoglobin measurement in the past 12 months[22]. These interventions are critical in reducing anemia burden for this group of children, who are most at risk[22].

The high prevalence of anemia among infants in this study is of concern[13]. 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[4,13,21]. 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[13,14,18,30]. On the contrary, females have been reported to be less likely to be anemic in Ethiopia[16] which is contrary to findings from Kenya where the risk was high in male children (aged 6 months to 14 years)[31], which could account for these differences. We did not find 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[7,16]. Higher education level of mothers is reported to be protective against childhood anemia[15,19,31].

Likewise, there was no association between nutritional characteristics such as uptake of deworming drugs, exclusive breastfeeding (EBF), colostrum feeding, complementary feeding, feeding frequency with anemia. However, other studies reported an association between nutritional characteristics with a higher risk of anemia in under five children[4,5,14,18,33]. On the contrary, Meinzen-Derr *et al.*[20] reported that, infants who are exclusively breast-fed for six months in developing countries may be at increased risk of anemia, especially among mothers with a poor iron status. 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[21,23,27].

Conclusion

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. Children in this age group were more likely to be anemic compared to those aged 24–59 months. No significant differences of anemia prevalence by sex of the child and any of the nutritional characteristics. 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.

Data availability

Underlying data

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

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)

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[26]

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)

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.

References

1. WHO: **Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity**. World Health Organization, 2011.
Reference Source
2. MoHCDGEC, MoH, NBS, *etal.*: **Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS) 2015-16**. Dar es Salaam, Tanzania and Rockville, Maryland, USA. 2016.
Reference Source
3. WHO: **Global nutrition targets 2025: anaemia policy brief (WHO/NMH/NHD/14.4)**. Geneva: World Health Organization; 2014.
Reference Source
4. Ayoya MA, Ngnie-Teta I, Séraphin MN, *et al.*: **Prevalence and risk factors of anemia among children 6–59 months old in Haiti.** *Anemia.* 2013; **2013**: 502968.
PubMed Abstract | Publisher Full Text | Free Full Text
5. Khan JR, Awan N, Misu F: **Determinants of anemia among 6–59 months aged children in Bangladesh: evidence from nationally representative data.** *BMC Pediatr.* 2016; **16**(1): 3.
PubMed Abstract | Publisher Full Text | Free Full Text
6. Kumar T, Taneja S, Yajnik CS, *et al.*: **Prevalence and predictors of anemia in a population of North Indian children.** *Nutrition.* 2014; **30**(5): 531–7.
PubMed Abstract | Publisher Full Text
7. Parbey PA, Tarkang E, Manu E, *et al.*: **Risk Factors of Anaemia among Children under Five Years in the Hohoe Municipality, Ghana: A Case Control Study.** *Anemia.* 2019; **2019**: 2139717.
PubMed Abstract | Publisher Full Text | Free Full Text
8. Phiri KS, Calis JC, Faragher B, *et al.*: **Long term outcome of severe anaemia in Malawian children.** *PLoS One.* 2008; **3**(8): e2903.
PubMed Abstract | Publisher Full Text | Free Full Text
9. Simbauranga RH, Kamugisha E, Hokororo A, *et al.*: **Prevalence and factors associated with severe anaemia amongst under-five children hospitalized at Bugando Medical Centre, Mwanza, Tanzania.** *BMC Hematol.* 2015; **15**(1): 13.
PubMed Abstract | Publisher Full Text | Free Full Text
10. Takele K, Zewotir T, Ndanguza D: **Risk factors of morbidity among children under age five in Ethiopia.** *BMC Public Health.* 2019; **19**(1): 942.
PubMed Abstract | Publisher Full Text | Free Full Text
11. Kassebaum NJ, Jasrasaria R, Naghavi M, *et al.*: **A systematic analysis of global anemia burden from 1990 to 2010.** *Blood.* 2014; **123**(5): 615-24.
PubMed Abstract | Publisher Full Text | Free Full Text
12. WHO: **The global prevalence of anaemia in 2011**. Geneva: World Health Organization; 2015.
Reference Source
13. Ewusie JE, Ahiadeke C, Beyene J, *et al.*: **Prevalence of anemia among under-5 children in the Ghanaian population: estimates from the Ghana demographic and health survey.** *BMC Public Health.* 2014; **14**(1): 626.
PubMed Abstract | Publisher Full Text | Free Full Text
14. Pita GM, Jiménez S, Basabe B, *et al.*: **Anemia in children under five years old in Eastern Cuba, 2005-2011.** *MEDICC Rev.* 2014; **16**(1): 16–23.
PubMed Abstract
15. Goswmai S, Das KK: **Socio-economic and demographic determinants of childhood anemia.** *J Pediatr (Rio J).* 2015; **91**(5): 471–7.
PubMed Abstract | Publisher Full Text
16. Mohammed SH, Habtewold TD, Esmaillzadeh A: **Household, maternal, and child related determinants of hemoglobin levels of Ethiopian children: hierarchical regression analysis.** *BMC Pediatr.* 2019; **19**(1): 113.
PubMed Abstract | Publisher Full Text | Free Full Text
17. Woldie H, Kebede Y, Tariku A: **Factors associated with anemia among children aged 6–23 months attending growth monitoring at Tsitsika Health Center, Wag-Himra Zone, Northeast Ethiopia.** *J Nutr Metab.* 2015; **2015**: 928632.
PubMed Abstract | Publisher Full Text | Free Full Text
18. Legason ID, Atiku A, Ssenyonga R, *et al.*: **Prevalence of anaemia and associated risk factors among children in North-western Uganda: a cross sectional study.** *BMC Hematol.* 2017; **17**(1): 10.
PubMed Abstract | Publisher Full Text | Free Full Text
19. Abubakar A, Uriyo J, Msuya S, *et al.*: **Prevalence and risk factors for poor nutritional status among children in the Kilimanjaro region of Tanzania.** *Int J Environ Res Public Health.* 2012; **9**(10): 3506–18.
PubMed Abstract | Publisher Full Text | Free Full Text
20. Meinzen-Derr JK, Guerrero ML, Altaye M, *et al.*: **Risk of infant anemia is associated with exclusive breast-feeding and maternal anemia in a Mexican cohort.** *J Nutr.* 2006; **136**(2): 452–8.
PubMed Abstract | Publisher Full Text
21. WHO, UNICEF: **Focusing on anaemia: Towards an integrated approach for effective anaemia control.** Geneva, Switzerland: World Health Organization; 2004.
Reference Source
22. Mitchinson C, Strobel N, McAullay D, *et al.*: **Anemia in disadvantaged children aged under five years; quality of care in primary practice.** *BMC Pediatr.* 2019; **19**(1): 178.
PubMed Abstract | Publisher Full Text | Free Full Text
23. MoHCDGEC: **The national road map strategic plan to improve reproductive, maternal, newborn, child & adolescent health in Tanzania (2016 - 2020): One Plan II.** Dar es Salaam, Tanzania. 2016.
Reference Source
24. NBS, OCGS: **Population Distribution by Age and Sex.** Dar es Salaam, Tanzania. 2013.
25. Swai SJ, Damian DJ, Urassa S, *et al.*: **Prevalence and risk factors for HIV among people aged 50 years and older in Rombo district, Northern Tanzania.** *Tanzania Journal of Health Research.* 2017; **19**(2).
Publisher Full Text
26. Mboya IB, Mamseri R, John B, *et al.*: **Questionnaire: Nutritional status of children U5 years of age in Kilimanjaro Region, Northern Tanzania.** V2 ed: figshare; 2020.
27. WHO: **Global nutrition targets 2025: breastfeeding policy brief.** World Health Organization, 2014.
Reference Source
28. Leroy JL: **ZSCORE06: Stata module to calculate anthropometric z-scores using the 2006 WHO child growth standards.** 2011.
Reference Source
29. Mboya IB, Mamseri R, John B, *et al.*: **Anaemia in children under five years of age in rural Tanzania.** V1 ed: Harvard Dataverse; 2020.
30. Menon MP, Yoon SS: **Prevalence and factors associated with anemia among children under 5 years of age—Uganda, 2009.** *Am J Trop Med Hyg.* 2015; **93**(3): 521–6.
PubMed Abstract | Publisher Full Text | Free Full Text
31. Ngesa O, Mwambi H: **Prevalence and risk factors of anaemia among children aged between 6 months and 14 years in Kenya.** *PLoS One.* 2014; **9**(11): e113756.
PubMed Abstract | Publisher Full Text | Free Full Text
32. Assis AMO, Barreto ML, da Silva Gomes GS, *et al.*: **Childhood anemia prevalence and associated factors in Salvador, Bahia, Brazil.** *Cad Saude Publica.* 2004; **20**(6): 1633–41.
PubMed Abstract | Publisher Full Text
33. Kejo D, Petrucka PM, Martin H, *et al.*: **Prevalence and predictors of anemia among children under 5 years of age in Arusha District, Tanzania.** *Pediatric Health Med Ther.* 2018; **9**: 9.
PubMed Abstract | Publisher Full Text | Free Full Text
34. Mgongo M, Hussein TH, Stray-Pedersen B, *et al.*: **We give water or porridge, but we don't really know what the child wants:" a qualitative study on women's perceptions and practises regarding exclusive breastfeeding in Kilimanjaro region, Tanzania.** *BMC Pregnancy Childbirth.* 2018; **18**(1): 323.
PubMed Abstract | Publisher Full Text | Free Full Text

Open Peer Review

Current Peer Review Status: ? ?

Version 1

Reviewer Report 08 October 2021

https://doi.org/10.5256/f1000research.27253.r95218

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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

https://doi.org/10.5256/f1000research.27253.r84355

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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 lowand 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

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 lowand 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 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 months 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.