The burden of anemia in pregnancy among women attending antenatal clinic in Mkuranga district, Tanzania

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Research

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Abstract

Background: The burden of anemia in pregnancy is of global health importance. Tanzania is no exception. It varies from one region to another owing to the differences in causes, but overall causing a significant burden of maternal mortality. This study sought to assess the prevalence and factors associated with anemia among pregnant women attending antenatal clinic (ANC) at Mkuranga district in Pwani region of Tanzania

Methods: This cross-sectional study design was conducted among 418 pregnant women aged 15-49 years attending the Mkuranga district hospital and Kilimahewa health centre. The outcome variable of interest was anemia in pregnancy defined as haemoglobin concentration of 13g/dl. Data was collected using face to face interviews with a standardized pretested questionnaire, and through blood samples collected for haemoglobin testing. Descriptive analysis was used to determine the prevalence of anemia while multiple logistic regression was used to determine factors associated with anemia in pregnancy.

Results: Anemia was prevalent among 83.5% of pregnant women attending the two major antenatal clinics in Mkuranga district were anemic. Of them, 29% presented with mild anemia, while 62% had moderate anemia, and 0.09% succumbed to severe anemia. Factors associated with anemia included being in the third trimester [AOR=2.87, p=0.026]; not consuming vegetables (AOR=2.62, p=0.008), meat (AOR=2.71, p=0.003), eggs (AOR=2.98, p=0.002), and fish (AOR=2.38, p=0.005).

Conclusion: More than eight in ten pregnant women attending ANC in Mkuranga districts were anemic. Such unprecedented burden of anemia is associated with a number of factors including feeding practices such as not consuming iron-rich foods like vegetables, meat, eggs, and fish. Women in their third trimester were also more likely to suffer from anemia. This unprecedented burden of anemia in pregnancy can be addressed if efforts to improve feeding practices and early monitoring at the antenatal clinics are sustained.

Introduction

About one in four women conceive with inadequate or absent iron stores with the levels of serum ferritin below 30mg/l, and up to 90% have iron stores of below 500mg, or with Serum ferritin below 70mg/l [1]. These are insufficient to meet the increased iron needs during pregnancy, delivery, and postpartum. Moderate to severe anemia in pregnancy especially of 28th weeks and above is behind the 23% maternal mortality globally [2]. It is associated with parasitic diseases such as malaria and worm manifestations, acute or chronic illnesses such as sickle cell, TB, HIV and different macronutrients disorders [3, 4, 5, 6].

Anemia is prevalent among 57.1% of pregnancy in Africa [7], but more common in Sub-Saharan owing to lower intake of iron and other micronutrients before and during pregnancy [8]. Pregnancy is iron demanding period due to a growing foetus and changing physiological status. Deficiency of iron during this period remains one of risk factors for maternal mortality and overall mortality in general population [6].

Evidence suggests that 45% of all women of reproductive age in Tanzania are anemic [9]. The burdens varies between and within regions. It ranges between 25% in Mbeya region to 72% in Kaskazini Pemba. Moreover, the burden is higher among pregnant women (57.1%) compared to the general population [9]. Routine administrative hospital records and surveys from Mkuranga district hospital suggest that anemia in pregnancy is a leading condition among of cases that are admitted in maternity ward. In absolute numbers, total number of admissions in maternity ward were 4800 among of them 3087 were admitted due to anemia in 2017.

Anemia in pregnancy has a number of maternal health effects such as preterm deliveries, heart failure, postpartum haemorrhage and even death [4]. For the foetuses, the effects includes low birth weight, birth asphyxia, and perinatal

death [10, 11, 12]. Babies born from anemic mothers are in greater risk of being impaired mentally, physically, and present with poor school performance [13]. Also, preterm infants are likely to have growth retardation and present with low stores of iron in their first year of life [14]. Anemia in pregnancy can therefore present long term consequences in the national economic development through low education attainment, reduced quality of life among people, decreased level of economic productivity and therefore a cycle of poverty [15].

Ensuring quality health care services in antenatal clinics can help addressing anemia and other pregnancy-related challenges [16]. Antenatal clinics are designed to provide an opportunity to pregnant women for variety of health care services including health education, counselling, screening, treatment, monitoring and promotion of mother's and foetuses wellbeing [16]. Many strategies have been implemented in the country to ensure pregnant women are receiving quality antenatal services concerning anemia. Such strategies include, testing of haemoglobin level in every antenatal visit, Intermittent preventive treatment in pregnancy (IPTp) for malaria prevention, provision of Insecticide-treated bed nets (ITN), ferrous sulphate tablet and de-worming. These services are targeted to be provided to every pregnant woman within the country through antenatal clinics.

The World Health Assembly set six targets that supposed to be accomplished by the year 2025, among of the targets is 50% reduction of anemia in women with reproductive age through several strategies such as food fortification with iron, folic acid and other micronutrients, distributions of iron containing supplements, control of infections and malaria [15]. Previous studies suggest that associated factors for anemia in pregnancy vary between and within regions. Since anemia is reported to take number one among all cases that are admitted in Mkuranga district hospital maternity ward, and considering the fact that there is no study which has been conducted to address the problem there is a need to identify the magnitude and factors associated with it.

Methods

Study setting

The study was conducted among women attending antenatal clinics at Mkuranga district hospital and Irene-Kilimahewa health centre, coastal region, Tanzania. The two facilities were selected based on their location and number of villages that they are serving. Mkuranga district hospital is located at Mkuranga centre(town) while Irene kilimahewa is located at 36 km from Mkuranga centre. Mkuranga district hospital RCH is providing services to 7 villages within the districts and also it is a referral centre for all health centres in the district while Irene-Kilimahewa serves 8 villages and it receive referral from ten dispensaries within district. All two facilities are providing blood transfusion services.

Study design and sampling method

The study population were pregnant women of reproductive age (that is women ages 15 – 49 years). Sample size was estimated by using **Fisher's formula** [17] $n = Z^2 P (1-P) / \square^2$. Where n is estimated minimum sample size; Z is confidence level at 95% (standard value is 1.96); P is proportion (prevalence of anemia during pregnancy 53% TDHS, 2010); $\square$ is precision at 95% CI = 0.05. The minimum sample that was required for this study was 399 pregnant women. A 5% non-response rate used to give a total sample size as 418 pregnant women.

Inclusion and exclusion criteria

The study included pregnant women attending ANC from first visit and above at Irene Kilimahewa health centre and Mkuranga district hospital RCH-ANC.The study excluded pregnant women that did not start first visit at Irene Kilimahewa health centre and Mkuranga district hospital (relocate). In addition, pregnant women who were not able to express themselves in either Kiswahili or English were excluded to participate in the study.

Data collection

Pregnant women aged 15-49 years attending ANC at Mkuranga district hospital and Irene Kilimahewa health center RCH-ANC were included. The study involved 418 participants who were conveniently sampled. Data were collected through structured questionnaire and blood sampling. The purpose of the study was explained to all eligible individuals. Those who accepted to participate were asked to sign the consent form.

Blood sample collection

The recently calibrated *Celltac Es Nihon Kohden* was used for haematology analyzation. To ensure the accuracy of the machine, laboratory technician run control test every day before starting the actual sample testing. The procedure of collecting sample for full blood picture test was as follow: Participants were required to go to the laboratory where they were instructed to sit upright on a chair and rest their arm face up on an elevated armrest. The laboratory technician tied a strap tourniquet around the top of their arms to temporarily restrict the blood flow from the arm back to the heart. This made the vein inside of client elbow “pop out,” and therefore easier to find. The area where the needle was inserted wiped with a sterile alcohol wipe to reduce any risk of infection. A needle inserted into the vein and a small amount of blood (4cc) drawn into the vial attached to the needle. After the procedure, laboratory technician press a small wad of cotton on the entry point to stop the flow of blood. The cotton wad strapped on with a band aid. Last, the participants were instructed that the cotton was only needed to remain on for a couple of minutes.

The findings obtained were recorded in the participant questionnaires. Based on World Health Organization (WHO) guideline, Hb level less than 11g/dl considered as anemia. Blood sample from Irene-Kilimahewa health centre were collected and kept in the cool box with the ice packs of 2-4^{0}c then transported to Mkuranga District Hospital where the test was conducted. The samples were tested within eight hours after been collected.

Tools and questionnaires

Questionnaire with structured questions used for collecting data that was assessing factors associated with anemia in pregnancy. Outcome variable of the study was anemia in pregnancy where by all pregnant women that was found with haemoglobin level <11g/dl were considered to be anaemic [6]. According to WHO, Anemia in pregnancy is categorized into three groups where by those with haemoglobin level of 10.0g/dl- 10.9g/dl considered to have mild anemia, 7.0g/dl-9.9g/dl moderate anemia and <7g/dl severe anemia[18]. Independent variables of the study were socio- economic and socio- demographics variables that was assessed by 34 questions adopted from Tanzania demographic health survey[9].

Household food insecurity, was assessed by using the tool adopted FANTA and WHO[19]. The tool has 9 questions that required the women to recall her eating experience in the past one month time basing of the nine item questionnaire. The average Cronbach’s alpha reliability coefficient for the instrument was 0.76. The lowest and highest values were 0 and 27 respectively. The scores were grouped into four categories; Food secure, mildly insecure, moderately insecure, and severely food insecure as recommended by the developer based on cut-off points. The tool was validated in developing countries including Tanzania [20].

Dietary diversity; pregnant women were asked to identify the type of food they took in the past 24 hours. A list of common food was adopted from tool developers. A list of 10 food groups provided by FANTA [21] was used to calculate the women dietary diversity score (WDDS). In this study, the WDDS had a mean score of 4.70 ±1.41 SD. Minimum dietary diversity was defined as it was instructed by the tool developers. The women who consumed five meals and above, considered to have minimal adequate dietary diversity. Also, the tool was validated[22]

Burden of disease; the impact of anemia in relation to other health conditions such as malaria was assessed through questions that was adopted from TDHS/MIS 2016. The tool was validated by the previous users within the country.

Data analysis

The analysis was conducted using STATA version 15. All probabilities were two-tailed and independent variables with p values <0.05 were regarded as significantly related with anemia. Descriptive statistics involving cross-tabulations was used to analyze categorical variables and results were presented in the form of frequency and percentage, while mean and standard deviation were presented for continuous variables. Logistic regression analysis was applied to determine factors associated with anemia among pregnant women. Bivariate regression was first fitted for each study variable to identify the independent variables that were associated with anemia. Variables that were significant in bivariate analysis with (P= 0.05) were then included in a multivariate analysis to obtain the adjusted factors associated with anemia. The results of the model were presented using odds ratios (OR) and 95% confidence interval (CI).

Results

Socio-demographic and economic characteristics of study participants

A total of 418 pregnant women aged between 15 and 49 years were included in this study (table 1). The average age of the included women was 26.19 years with standard deviation of 6.82 years. About (26.2%) of the respondents were aged 20- 24 years. Majority of study participants (84.3%) were married. About 76.6% of the women reported to have been enrolled to formal education at least once in their lifetime. Most of the participants (54.3%) were involved in agriculture activities. Participants had a fairly equally distributed wealth category. Majority were in their third trimester of the pregnant which accounts 225 (53.8%). Out of the total participants, 257 (61.5%) were in their 2nd trimester at first ANC. It was found that, 359 (86.1%) participants had no malaria. Of the entire participants, majority, 173 (41.4%) reported to have 1-2 children in the household. More than ninety percent reported to have slept under the net last night. It was observed that more than half of the included women were having minimally adequate diet diversity (51.2%) and 48.8% were not having minimally adequate diet diversity. Majority (76.9%) of the households experienced severely food insecure and 10.3% had food secure

Table 1: Characteristics of participants in relations to Anemia status

Variable	Normal		Anemic		P-Value
	N	%	N	%	
Age					
< 19	8	11.3	63	88.7	0.463
20-24	17	13.9	105	86.1	
25-29	17	17.7	79	82.3	
30-34	15	21.7	54	78.3	
35-39	9	21.4	33	78.6	
40+	2	11.1	16	88.9	
Education level					
No formal education	16	16.3	82	83.7	
Primary education	36	14.9	205	85.1	
Secondary or higher	16	20.3	63	79.7	0.552
Current marital status					
Married or living together	61	17.6	285	82.4	0.104
Not married	7	9.7	65	90.3	
Financial activity					
Profession/Technical/Managerial	3	4.4	0	0.0	
Clerical	1	1.5	0	0.0	
Sales and services	20	29.4	0	0.0	
Skilled Manual	20	29.4	0	0.0	.999
Unskilled Manual	0	0.0	75	21.4	
Domestic services	21	30.9	0	0.0	
Agriculture	0	0.0	227	64.9	
Not employed	3	4.4	48	13.7	
Wealth index quintiles					
Lowest	11	12.8	75	87.2	
lower	11	13.4	71	86.6	0.477
Middle	13	15.7	70	84.3	
Higher	19	22.4	66	77.6	
Highest	14	17.1	68	82.9	
Pregnancy trimester					
1st trimester	16	34.0	31	0.09	
2nd trimester	26	17.8	120	34.2	0.021

3rd trimester	26	11.6	199	**0.56**	
Pregnancy trimester at first ANC visit					
1st trimester	143	40.3	212	59.7	0.032
2nd/3rd trimester	265	**52.7**	238	**47.3**	
Malaria test results					
Positive	0	0.0	58	100	0.997
Negative	67	18.7	292	81.3	
Number of children in household					0.2403
None	18	12.86	122	87.14	
1-2	28	16.18	145	83.82	
3+	22	20.95	83	79.05	
Sleep under treated net last night					
Yes	62	15.58	336	84.42	0.097
No	6	30.00	14	70.00	
MDD-W					**0.000**
Reached MDD-W	**0**	**0.0**	**214**	**100**	
Not reached MDD-W	**68**	**33.3**	**136**	**66.7**	
Household Food Security Status					
Food Secure	**8**	**18.6**	**35**	**81.4**	**0.002**
Food Insecure	**60**	**16**	**315**	**84.0**	

The hemoglobin measurements were taken among the pregnant women, and the mean hemoglobin level was reported to be 9.5g/dl with standard deviation of 1.6 g/dl. The overall magnitude of anemia (hemoglobin level < 11 g/dl) was 83.7%. Categorically, 16.3% were normal, 51.9% had moderate anemia, 24.4% mild anemia and 7.2 % had severe anemia.

Factors associated with anemia among pregnant women

Social demographic and socio-economic factors of the pregnant women were compared with the anemic status. In bivariate analysis the associations between individual independent variables and dependent variable (anemia) did not reach a statistical difference at 5% level of significance (Table 2). The prevalence of anemia was higher among women who were currently married or living together with a man (81.4%) as compared to unmarried counterparts (18.6%), although this difference did not reach a statistical significant level. In general, women who attended secondary or higher education had a lower burden of anemia (18.0%) compared to those with no formal education (23.4%) and primary education level (58.6%). In this study, the prevalence of anemia was evenly distributed among wealth quintiles. However, these results were showed no statistically significant association in both bivariate and multivariate analyses.

The results of bivariate analysis showed that pregnant trimesters (p=0.001) and pregnancy trimester at first ANC visit (p=0.032) were significantly associated with anemia among pregnant women. The association was also significant in multivariate analysis for pregnant trimesters and trimester at first ANC visit, p=0.023 and p=0.026 respectively. Women whose pregnancy was at second (OR=2.38, p=0.021) and third trimester (OR=3.95, p<0.001) were significantly more likely

to have anemia as compared to women with pregnancy at first trimester. However, in multivariate analysis only women in third trimester were significantly associated with anemia. In addition, women started the first ANC visit at second or third trimester of pregnancy were significantly more prevalent to have anemia than women started the ANC visit during the first trimester (OR=1.78, p=0.032). The results were however non-significant in multivariate analysis.

It was also noted that women who did not consume vegetables, meat, eggs, and fishes were significantly more likely to be anemic than women who consumed, OR=2.43 p=0.008, OR=2.63 p=0.001, OR=3.42 p=0.001, and OR=2.45 p=0.002 respectively. In multivariate analysis, the results were also significant.

Table 2: Bivariate and multivariate analysis of factors associated with anemia among pregnant women attending ANC in Mkuranga district hospital

Variable	Anemia, n (%)		OR (95%, CI)	p-Value	AOR (95%, CI)	p-Value
	No	Yes				
Age				0.463		0.620
< 19	8(11.8)	63(18.0)	Reference		Reference	
20-24	17(25.0)	105(30.0)	0.78[0.32,1.92]	0.595	0.66 [0.25,1.76]	0.411
25-29	17(25.0)	79(22.6)	0.59[0.24,1.46]	0.252	0.77 [0.28,2.14]	0.615
30-34	15(22.1)	54(15.4)	0.46[0.18,1.16]	0.100	0.50 [0.17,1.41]	0.191
35-39	9(13.2)	33(9.4)	0.47[0.16,1.32]	0.150	0.37 [0.11,1.23]	0.108
40+	2(2.9)	16(4.6)	1.02[0.19,5.26]	0.985	0.68 [0.11,4.18]	0.682
Education level						
No formal education	16 (23.5)	82 (23.4)	Reference			
Primary education	36 (52.9)	205(58.6)	1.11[0.58,2.11]	0.748		
Secondary or higher	16 (23.5)	63 (18.0)	0.77[0.36,1.65]	0.500		
Current marital status						
Married or living together	61(89.7)	285(81.4)	Reference		Reference	
Not married	7(10.3)	65(18.6)	1.99[0.87,4.55]	0.104	2.04 [0.82,5.07]	0.124
Financial activity						
Profession/Technical/Managerial	3(4.4)	0(0.0)	Reference			
Other activities	65(95.6)	350(100)	0.000[0.000]	0.999		
Wealth index quintiles						0.724
Lowest	11(16.2)	75(21.4)	Reference		Reference	
lower	11(16.2)	71(20.3)	0.95[0.39,2.32]	0.905	0.84 [0.31,2.26]	0.737
Middle	13(19.1)	70(20.0)	0.79[0.33,1.87]	0.593	0.99 [0.37,2.64]	0.983

Higher	19(27.9)	66(18.9)	0.51[0.23,1.14]	0.104	0.65 [0.26,1.63]	0.362
Highest	14(20.6)	68(19.4)	0.71[0.30,1.67]	0.437	1.20 [0.44,3.23]	0.722
Pregnancy trimester				**0.001**		**0.023**
1st trimester	16(23.5)	31(8.9)	Reference		Reference	
2nd trimester	26(38.2)	120(34.3)	2.38[1.14,4.97]	**0.021**	1.48 [0.56,3.97]	0.430
3rd trimester	26(38.2)	199(56.9)	3.95[1.91,8.18]	**<0.001**	2.87 [1.13,7.25]	**0.026**
Pregnancy trimester at first ANC visit						
1st trimester	31(45.6)	112(32.0)	Reference		Reference	
2nd /3rd trimester	37(54.4)	238(68.0)	1.78[1.05,3.02]	**0.032**	1.42 [0.69,2.93]	0.342
Malaria test results						
Positive	0 (0.0)	58 (100.0)	370674027.1[0.0]	0.997		
Negative	67 (18.7)	292 (81.3)	Reference			
Household Food Security Status						
Food Secure	8(11.8)	35(10.0)	1.20[0.53,2.71]	0.662		
Food Insecure	60(88.2)	315(90.0)				
Consumed vegetables						
No	12(17.6)	120(34.3)	2.43[1.26,4.72]	**0.008**	2.62 [1.28,5.38]	**0.008**
Yes	56(82.4)	230(65.7)	Reference		Reference	
Consumed meat						
No	45(66.2)	293(83.7)	2.63[1.48,4.68]	**0.001**	2.71 [1.39,5.25]	**0.003**
Yes	23(33.8)	57(16.3)	Reference		Reference	
Consumed eggs						
No	48(70.6)	312(89.1)	3.42[1.84,6.36]	**<0.001**	2.98 [1.47,6.03]	**0.002**
Yes	20(24.4)	38(10.9)	Reference		Reference	
Consumed fishes						

No	21(30.9)	183(52.3)	2.45[1.41,4.27]	**0.002**	2.38 [1.29,4.29]	**0.005**
Yes	47(69.1)	167(47.7)	Reference		Reference	

Discussion

We conducted a study that focused on assessing the magnitude of anemia, factors associated with it among pregnant women attending two antenatal clinics within Mkuranga district. The study found that 83.7% of pregnant women attending ANC at Mkuranga district were anaemic. According to WHO, classification of public health importance of anemia, the observed figure implies anemia in pregnancy is a serious public health problem in the study setting[23]. The prevalence of anemia found in this study is higher compared to the national prevalence of 57.1% [9]. This study's prevalence is also higher compared that found in Moshi (18.0%) [4] and Dar es Salaam (68.0%), Tanzania [13]. This findings might be implicated with cultural practices and eating pattern of coastal region people since they always not prefer much vegetable and fruits in their diet knowingly or unknowingly of the effects that might be associated with that practice. It is reported that, prevalence of anemia in developed countries range between 3–18% while in developing countries range between 35% – 75%[1, 4, 24].

Like in other studies conducted within Africa, Majority of those who were anemic, were pregnant women aged 20–24 years, having primary level of education, married, with lowest wealth index. Low level of education was discussed in many studies that it might increase the chance of someone's to get anemia due to the fact that educated women have a greater chance of getting proper information in relation to health issues like anemia. Also being educated may influence someone to comprehend the information that is provided at ANC. Women's wealth status was also considered to be among of the predicators of anemia in pregnancy due to the fact that, pregnant women with low to middle wealth index, considered not to be able to get enough number meals thing that can lead to anemia. This findings looks similar with the findings from several studies conducted in Ethiopia, Ghana and Malaysia that also tells pregnant women wealth status and occupation may contribute to anemia[1, 25, 26].

Majority of pregnant women who were included in this study experienced moderate anemia followed by mild anemia. These findings are similar with those from Moshi, Tanzania in which majority of the participants had moderate anemia 8.1% followed by mild 7.6% then severe anemia that was 2.3% of all participants [4]. However, findings from this study found to be opposite of what was found in the studies done in Gondar, Northwest Ethiopia [27], rural Jordan [28] and China [29] where majority had mild anemia followed by moderate anemia. This difference may be the result of geographical variation of factors across different areas and eating pattern of the participants.

Anemia among pregnant women was found to be statistically significant with pregnancy third trimester. Studies shows there is increase in blood volume during pregnancy time which may lead to decrease in iron store. As the number of trimester increases, the demand for iron in the body also increase therefore, there is a great chance for those who are in third trimester to develop anemia compared to those in first trimister. These findings are supported by the studies done in tertiary referral hospital, Northern Ghana and [30] and Pumwani Maternity Hospital, Kenya [31]. The study also found that anemia was more prevalent to women who started their ANC visits at the second or third trimester. These women are likely to get iron and folic acid supplementation for a shorter duration during pregnancy as compared to those who started attending ANC earlier. This may have contributed to the high prevalence of anemia recorded in this study [31]. The association was statistically significant.

Not consuming vegetables, meat, eggs, and fishes were significantly associated with being anemic. This can be due to the fact that, these are iron-rich foods, hence little or no consuming them can be an important contributor to anemia. The studies done in the Volta Region, Ghana [32] and northern central Ethiopia [33] support these findings. Inadequate intake

of micronutrients in food insecure households can be a result of under-consumption of food, or overconsumption of energy-dense but nutrient-poor diet which are becoming increasingly cheaper sources of calorie for poor consumers[34]. The current study also reported inadequate dietary diversity, which was significantly associated with anemia. Food diversity is advised to pregnant women since it is a period, which demands physiologically high nutrition than usual. Similar findings were reported from the study done in West Ethiopia [35] and from Southern Ethiopia [1]. Other contributing factors to higher prevalence may be low income and number of children. These factors are commonly cited in number of studies [4, 8, 10, 14, 36].

Limitation

The study was an institutional based study. To make these findings stronger, further community level study should be conducted. Also, the study excluded those who were severely ill and unable to respond due to difficulty in obtaining venous sample. This may have reduced the prevalence of anemia.

Conclusion

Anemia is prevalent in more than eight in every ten pregnant women attending ANC in Mkuranga district, Tanzania. Factors associated with anemia in pregnant included pregnancy at third trimester, non-consumption of vegetables, meat, eggs, and fishes. patients about sources of iron and ways to improve its absorption, clarify concerning the risks of anemia and the importance to take iron supplements during pregnancy. Health care providers should inform pregnant women as well as women of reproductive age about sources of iron-rich foods and ways to improve its absorption, and clarifying the risks of anemia and the importance to take iron supplements during pregnancy. Strengthened health education on risk factors should be promoted to create awareness.

Abbreviations

ANC: Antenatal Care; AOR: Adjusted Odds Ratio; CI: Confidence Interval; Hb: Hemoglobin level; HDDS: Household Dietary Diversity Score; HFIAS: Household food insecurity access scale; IPTp: Intermittent preventive treatment in pregnancy; ITN: Insecticide-treated bed nets; OR: Odds Ratio; RCH: Reproductive and Child Health; TDHS-MIS: Tanzania Demographic and Health Survey-Malaria Indicator Survey; WHO: World Health Organization

Declarations

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Availability of data and materials

The data used during the current study is available from corresponding author.

Authors' contributions

EN designed the study, conducted data collection, did data analysis and interpretation of findings, wrote and approved the manuscript. BS and SM provided technical inputs to improve designing the study, supported data analysis, read, improved, and approved the final manuscript write-up. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval from the Muhimbili University of Health and Allied Sciences (MUHAS), Research Ethical Committee (REC) was granted for this study (Ref No.DA 25/111/01/). Permission to carry out the study in Mkuranga District was obtained from District Executive Director and District Medical Officer. Participants in the study were provided with informed consent after being informed about objectives and rationale of the study. Participants in the study were free to choose whether to participate in the study or not. Information collected from the participants were kept confidential, no names or any personal identity appeared in the study.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interest.

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