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RESEARCH

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The prevalence of low birth weight and its associated maternal factors among women of reproductive age who gave birth to live babies within five years preceding the survey in Tanzania: an analysis of data from the 2015-16 Tanzania Demographic and Health Survey and Malaria Indicators Survey

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Abstract

Background Infant survival is an important factor in any community's health. Low birth weight affects babies not only during their infancy but also has long-term consequences for their health as adults. Unfortunately, Sub-Saharan Africa as a region is still dealing with the burden of Low birth weight (LBW), and Tanzania as a part of this region is no exception. So this study aimed to determine the Magnitude of Low Birth Weight and Its Associated Maternal Factors among Women of Reproductive Age who gave birth to live babies.

Methods The study used analytical cross-sectional study design to analyze secondary data from the Tanzania Demographic and Health Survey and Malaria Indicators Survey 2015–2016. A total of 4,644 women of reproductive age who gave birth to live babies within five years preceding the survey were included in the study. Both bivariate and multivariable logistics regression analyses were used to assess maternal factors associated with low birth weight.

Results The prevalence of LBW was 262(6.2%). After adjusting for confounders, the maternal factors associated with LBW were Age group of a pregnant woman [Less than 20 years (aOR = 1.907 CI = 1.134–3.205) in reference to those aged more than 34years], Number of ANC visits made [Inadequate visits (aOR = 1.612 CI = 1.266–2.05)], parity [para 2–4 (aOR = 0.609 CI = 0.453–0.818), para 5+ (aOR = 0.612 CI = 0.397–0.944)] and area of residence [Unguja (aOR = 1.981 CI = 1.367–2.87).

Conclusion The prevalence of low birth weight in Tanzania remains high. Women's age, parity, number of Antenatal care visits (ANC), and area of residence were found to be maternal factors associated with LBW. Thus, early prenatal

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diagnosis of risk factors for low birth weight in high-risk pregnant women may help to reduce the LBW burden in Tanzania and its detrimental effects.

Keywords Prevalence, Low birth weight, Maternal factors, Tanzania

Background

An infant ever-changing milestones, health, and survival depend on its birthweight among other factors. Defined by World Health Organization (WHO), low birth weight (LBW) refers to a birth weight of less than 2500 g (5.5 lb). LBW is a major public health issue around the world. It is a serious health concern for newborns. The policy brief on low birth weight envisions a 30% reduction in low birth weight by 2025 [1].

The proportion of total LBW in all live births worldwide is between 15% and 20%. This indicates that more than 20 million live births that occur yearly are LBW. It is staggering to note that nearly half of all births associated with LBW occur in South-Central Asia, while 15% occur in Sub-Saharan Africa [2]. LBW is responsible for 60–80% of all neonatal deaths worldwide [3]. Several studies have reported on the magnitude of LBW, indicating that it is a concern in many countries. In Bangladesh, the prevalence of LBW is as high as 23% [4]. A study of ten countries found that the average prevalence of LBW was about 15.9%, with Indonesia recording the highest LBW rate of 37.3% of all the countries studied [5]. A study which was done in selected facilities in Tanzania and Kenya indicated that the magnitude of LBW was 10% and 7.8% respectively [6].

LBW outcomes include, but are not limited to cognitive issues, Low Intelligence Quotient (IQ), hypoglycemia immunosuppression, and delayed milestones. The risk of dying from complications is 20 times higher in these babies in comparison to babies born within a normal weight range [7].

Different studies have linked the cause of LBW to a variety of factors being it fetal, maternal, infectious and other factors. Infant causes may include preterm birth or Intrauterine growth restriction and sometimes a combination of both [8].Maternal characteristics contributing to LBW involve nutrition status of a woman, birth interval, ANC follow-up, obesity, drug use, maternal height of less than 150, lack of folic acid intake during pregnancy and maternal age [7–10]. Infections also play a role in the cause of LBW and these include malaria infection in pregnancy, anemia and Human Immunodeficiency Virus (HIV) status of the mother. Other factors include environmental factors, and genetic factors like previous history of giving a small baby, history of a mother being born with LBW. All of these factors have been shown to have a significant impact on birth weight [8, 11, 12].

Neonatal mortality rates in Sub-Saharan Africa remain particularly alarming. Without a doubt, the Tanzanian government has taken enormous efforts to combat LBW, like improving maternal health through ensuring access to healthcare services even to marginalized communities, provision of quality antenatal care, family planning services, ensuring continuous improvement of clinical knowledge and skills of health providers so as to provide integrated care to high risk pregnant women [13, 14]. Even with the effort put forward but the problem persists, and very few studies have been conducted to explore the maternal factors that are directly linked to LBW. Therefore, this study aimed to determine the Magnitude of Low Birth Weight and Its Associated Maternal Factors among Women of Reproductive Age who gave birth to live babies in Tanzania.

Methods

Study area and period

This study was based on secondary data sources from Tanzania Demographic and Health Survey and Malaria Indicators Survey 2015–2016. The survey was done in the United Republic of Tanzania from August 22nd, 2015 to February 14th, 2016. The country is located south of the equator and bordered by eight countries. To the north there are Kenya and Uganda, to the west there are Rwanda, Burundi, the Democratic Republic of Congo, and Zambia. Malawi and Mozambique are in the south.

Study design

The study used analytical cross-sectional study design to analyze the 2015-16 Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS) data. The survey was led by the National Bureau of Statistics (NBS) and the Office of Chief Government Statistician (OCGS), Zanzibar, in collaboration with the Ministry of Health in Tanzania Mainland and the Ministry of Health of Zanzibar. The data collected were fertility levels, marriage, sexual activity, fertility preference, awareness and use of family planning methods, breastfeeding practices, nutrition, childhood and maternal mortality, maternal and child health, malaria, and other health-related issues.

The 2015-16 TDHS-MIS

The 2015-16 TDHS-MIS is a national based cross-sectional study utilizing the 2015-16 Tanzania Demographic and Health Survey and Malaria Indicator Survey (2015-16 TDHS-MIS) dataset. The primary objective of the 2015-16 TDHS-MIS was to provide up-to-date estimates of basic demographic and health indicators. The survey collected information on fertility levels, marriage, sexual activity, fertility preferences, awareness and use of family planning methods, breastfeeding practices, nutrition, childhood and maternal mortality, maternal and child health, malaria, and other health-related issues.

The sample design for the 2015-16 TDHS-MIS was done in two stages and was intended to provide estimates for the entire country, for urban and rural areas in Tanzania Mainland, and for Zanzibar. The first stage involved selecting sample points (clusters), consisting of enumeration areas (EAs) delineated for the 2012Tanzania Population and Housing Census. A total of 608 clusters were selected. In the second stage, a systematic selection of 13,360 households was done and out of those households selected, 12,767were occupied. Of the occupied households, 12,563 were successfully interviewed, yielding a response rate of 98%. In the interviewed households, 13,634 eligible women were identified for individual interviews; interviews were completed with 13,266 women, yielding a response rate of 97%.

Study population and data extraction

The subset of the original TDHS-MIS dataset was extracted using the criteria of women of reproductive age who gave birth to live babies within five years preceding the survey. All other outcome variables in the subset of the TDHS-MIS were dropped and a total of 6924 women were included. Furthermore, the outcome variable was assessed and all women of reproductive age who gave birth to live babies with no response to the birth weight of their neonates were removed. The final sample size used in this study was 4,644 women of reproductive age who gave birth to live babies. A sampling weight was utilized to ensure the representativeness of the study sample.

Data collection tool

The survey used household questionnaires and individual questionnaires. They are based on Measure Demographic and Health Survey (DHS) standards, Acquired Immunodeficiency Syndrome (AIDS) Indicator Survey and Malaria Indicator Survey questionnaires standards. The tool was translated into Kiswahili, the National language of Tanzania. The data used for this study were those collected using the individual questionnaire.

Variables

Figure 1 below shows the conceptual framework which was developed to guide the conceptualization. The framework had independent variables (socio-demographic characteristics, obstetric characteristics, and maternal services, ANC utilization, place of childbirth ever took malaria, iron supplement and deworming). The maternal age was categorized into three categories, those who were aged less than 20 years, those aged 20 to 34 years and those aged more than 34 years. Wealth index in this study was categorized into three categories, poor wealth index, middle wealth index and rich wealth index. From the original DHS data, the first two categories (poorest and poorer) were combined to form poor wealth index

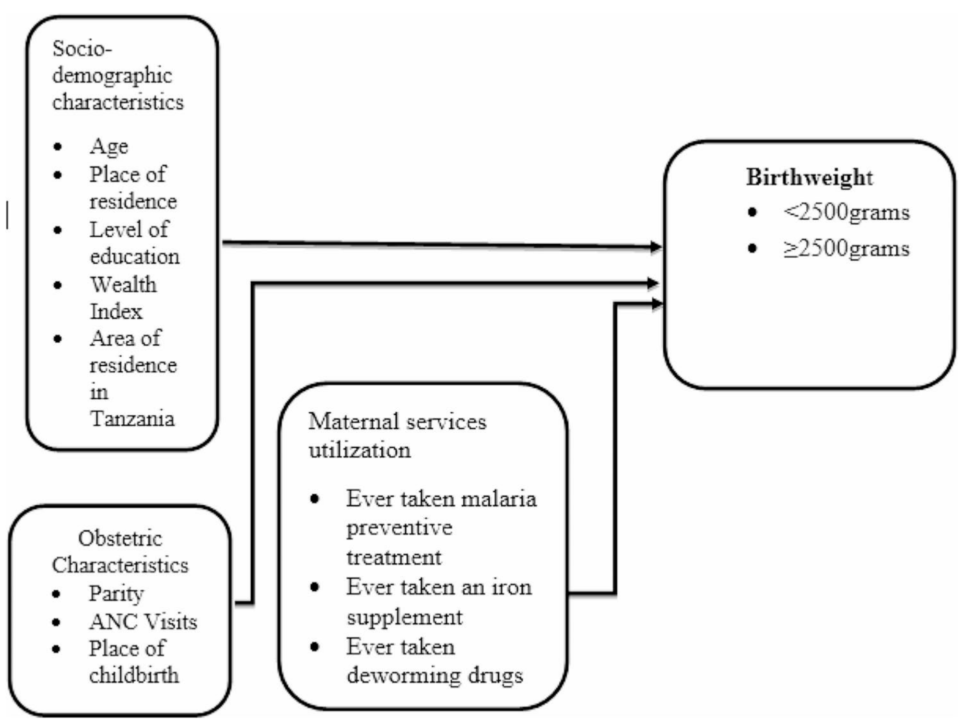

Fig. 1 Conceptual framework

Table 1 Socio-demographic characteristics of women of reproductive age who gave birth to live babies (*n* = 4,197)

Variables	Frequency(*n*)	Percent (%)
Age Groups		
Less than 20 years	340	8.1
20 to 34 years	2886	68.8
More than 34 years	971	23.1
Type of place of residence		
Urban	1826	43.5
Rural	2371	56.5
Highest educational level		
No education	458	10.9
Primary	2728	65
Secondary	951	22.7
Higher	60	1.4
Wealth Index		
Poor	1114	26.5
Middle	724	17.2
Rich	2359	56.2
Place of childbirth		
Health facility	3953	94.2
Outside facility	244	5.8
Ever took malaria prophylaxis		
No	925	22
Yes	3272	78
Iron supplement		
No	618	14.7
Yes	3579	85.3
Number of Antenatal Care (ANC) Visits		
Inadequate	1711	40.8
Adequate	2486	59.2
Parity of the Respondent		
Para one	1240	29.6
2 to 4	2059	49
Para 5+	898	21.4
De-worming		
No	1220	29.1
Yes	2977	70.9
Areas in Tanzania		
Mainland Rural	1787	42.6
Mainland Urban	2302	54.8
Unguja	84	2
Pemba	24	0.6

category, middle wealth category was maintained and the last two categories (richer and richest) were combined to form rich category. Two categories (adequate and inadequate) were used for ANC services utilization. For pregnant women who made at least four ANC visits were considered as had adequate ANC services utilization and for those who made less than or no visit were considered as had inadequate ANC visits. For the place of childbirth, there were two categories either in health facility or outside health facility (home or birth before arrival). For anemia preventive services (deworming, intermittent preventive treatment of malaria and iron supplement), these variables were assessed based on whether interviewed women took the service at least once. The dependent variable was the birth weight of neonates. The neonates assessed were the youngest child born within five years preceding the survey. The dependent variable had two categories, low birth weight (weight less than 2500 g) and this was coded as 1 and normal birth weight (weight of ≥2500 g).

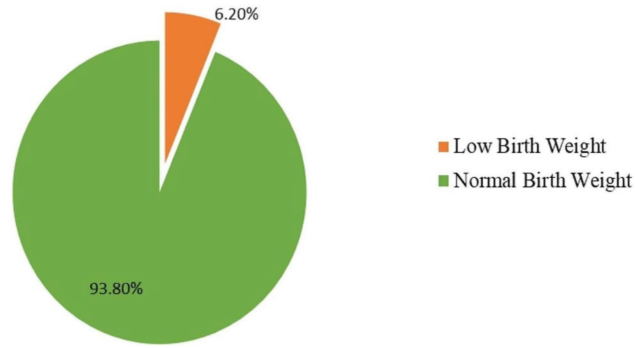

Fig. 2 Prevalence of birth weight

Data analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 25. All variables were described using frequencies and percentages. The relationships between independent variables (maternal characteristics) and outcome variable (birth weight) were assessed using a chi-square test. All variables with p-value ≤ 0.05 were entered into a regression model. First bivariate analysis was done to establish the Crude Odds ratio (COR). The maternal factors associated with low birth weight were established using multivariable logistic regression. Adjusted Odds Ratios (AOR) with a 95% Confidence Interval (CI) and p-value of 0.05 was used to identify significant maternal factors associated with low birth weight.

Results

The majority of study respondents were aged 20-34years, were living in rural areas, had a primary level of education, were rich, had birth in a health facility, never took malaria treatment, and had 2 to 4 children (Table 1).

Birth-weight

A total of 262 (6.2%) neonates were born with low birth weight while 3935(93.8%) were born with normal birth weight (Fig. 2).

The relationship between pregnant women's characteristics and neonatal birth weight

Variables that showed a significant relationship with neonatal birth weight were age group ($X^2 = 35.442$, $p < 0.001$), ever received intermittent treatment for malaria at least once (X^2=5.98, p=0.014), number of antenatal visits the pregnant women made (X^2=12.432, p<0.001), parity of the mother (X^2=27.478, p<0.001) and area of residence (X^2=9.686, p=0.02) Table 2.

Table 2 The relationship between mothers' characteristics and neonatal birth weight (n=4,197)

Variables	Normal BW *n*(%)	Low BW *n*(%)	X^2	*p*-value
Age Groups			35.442	< 0.001
Less than 20 years	289(84.9)	51(15.1)		
20 to 34 years	2733(94.7)	153(5.3)		
More than 34 years	913(94.1)	58(5.9)		
Type of place of residence			0.291	0.589
Urban	1706(93.4)	120(6.6)		
Rural	2229(94)	142 [6]		
Highest educational level			2.502	0.475
No education	422(92.1)	36(7.9)		
Primary	2562(93.9)	166(6.1)		
Secondary	892(93.8)	59(6.2)		
Higher	59(99.3)	1(0.7)		
Wealth Index			0.592	0.744
Poor	1045(93.8)	69(6.2)		
Middle	674(93.1)	50(6.9)		
Rich	2216(93.9)	143(6.1)		
Place of childbirth			0.102	0.749
Health facility	3710(93.9)	243(6.1)		
Outside facility	225(92.2)	19(7.8)		
Ever took malaria prophylaxis			5.98	0.014
No	852(92.1)	73(7.9)		
Yes	3083(94.2)	189(5.8)		
Iron supplement			3.307	0.069
No	594(96.1)	24(3.9)		
Yes	3341(93.4)	238(6.6)		
Number of Antenatal Care (ANC)Visits			12.432	< 0.001
Inadequate	2359(94.9)	127(5.1)		
Adequate	1576(92.1)	135(7.9)		
Parity of the Respondent			27.478	< 0.001
Para one	1122(90.4)	118(9.6)		
2 to 4	1967(95.5)	92(4.5)		
Para 5+	846(94.3)	51(5.7)		
De-worming			2.245	0.134
No	1133(92.9)	86(7.1)		
Yes	2802(94.1)	176(5.9)		
Areas in Tanzania			9.686	0.021
Mainland Rural	1672(93.5)	115(6.5)		
Mainland Urban	2166(94.1)	136(5.9)		
Unguja	75(89.4)	9(10.6)		
Pemba	22(92.8)	2(7.2)		

Factors associated with low birth weight

Factors associated with low birth weight were the age group of a pregnant woman [Less than 20 years (aOR=1.907 at 95%CI=1.134–3.205, p=0.015)], Number of ANC visits made [Inadequate visits (aOR=1.612 at 95%CI=1.266–2.052, p<0.001)], parity [para 2–4(aOR=0.609at 95%CI=0.453–0.818,p=0.001), para 5+ (aOR=0.612 at 95%CI=0.397–0.944,p=0.026) and area of residence [Unguja (aOR=1.981 at95%CI=1.367–2.87, p<0.001) Table 3.

Discussion

LBW is an important indicator of neonatal mortality and morbidity, it is a priority issue in children's health globally. LBW prevalence varies greatly. According to the findings of the current study, 6.2% of all births are LBW. These findings are consistent with the findings of studies conducted in selected African countries in which the prevalence of LBW in Uganda was 10% [15]. Also, another study conducted in Subsaharan Africa indicated that the prevalence of LBW in Guinea was 6.3% [2] This agreement can be explained by the fact that both studies were community surveys. However, the prevalence of LBW in this study is lower than the studies conducted in South Sudan 23.5% [16] and Kolkata 38% [17]. This discrepancy may be due to design and geographical area differences with the current study.

Pregnant women's characteristics have increasingly been linked as an important element of a neonate's birth weight. In this study, the age group of women, the number of antenatal visits made by pregnant women, the mother's parity, and the area of residence were all significantly related to neonate birth weight.

Women of less than 20 years of age were more likely to deliver babies with low birth weight compared to those aged 34 and above. This result may be attributed to the fact that women aged 20 and under are likely to be pregnant for the first time at this age and may have little antenatal experience. As a result, this may negatively influence the weight of the baby as they can't articulate what's best for themselves and the baby in terms of nutrition and healthcare-seeking behavior [18]. This finding is consistent with a study conducted in India, which found a 50% prevalence of LBW among women aged 18 and under [19]. On the other hand, this finding is not in agreement with the study done in Malaysia where it was revealed that there was no statistically significant difference between maternal age and the chance of delivering low birth weight infants [20]. The difference between these two studies may be attributed to variations in study time and setup.

Furthermore, women who received inadequate antenatal care visits were more likely to have babies with LBW than their counterparts who received adequate

Table 3 Factors associated with low birth weight

Variables	OR	CI		*p*-value	CI		Upper	*p*-value
		Lower	Upper		aOR	Lower		
Age Groups								
More than 34	1				1			
20 to 34 years	1.108	0.827	1.483	0.493	0.982	0.675	1.428	0.925
Less than 20	2.782	1.882	4.113	0	1.907	1.134	3.205	0.015
Ever took malaria prophylaxis								
Yes	1				1			
No	1.363	1.062	1.748	0.015	1.116	0.856	1.456	0.417
Number of Antenatal Care (ANC)Visits								
Adequate	1				1			
Inadequate	1.52	1.203	1.92	0	1.612	1.266	2.052	< 0.001
Parity of the Respondent								
Para one	1				1			
2 to 4	0.532	0.408	0.692	0	0.609	0.453	0.818	0.001
Para 5+	0.532	0.388	0.729	0	0.612	0.397	0.944	0.026
Areas in Tanzania								
Mainland Rural	1				1			
Mainland Urban	1.095	0.839	1.428	0.505	1.196	0.907	1.575	0.204
Unguja	1.732	1.219	2.463	0.002	1.981	1.367	2.87	< 0.001
Pemba	1.216	0.676	2.189	0.513	1.205	0.665	2.184	0.538

ANC visits. Tanzania's Ministry of Health adopted the Focused Antenatal Care model from WHO in year 2002 which recommended a minimum of four antenatal visits. Among other services, women are given health education about the risks of LBW and how to avoid them during these visits. That could explain why there is a difference in the overall health of a newborn baby between those who had an adequate visit and those who did not [21]. This finding is supported by the findings of a study done in Iraq which concluded that there was an association between ANC visits and LBW in which attending at least four visits is linked with a low prevalence of LBW [22]. On the other hand, this finding was not congruent with a study done in Northwest Ethiopia which displayed no significant association between low birth weight and ANC follow-up [23]. This disagreement can be explained by the socio-cultural difference between the participants.

Furthermore, the study findings revealed that parity is one of the determinants of LBW. Women with 2–4 children were 0.609 more likely to have babies with LBW, while those with 5+parity were 0.612 more likely to have neonates with LBW than their counterparts with less than 2 children. This study supports the findings of an Ethiopian study. The study found that women with parity 5 or more had a higher chance of having LBW babies than multiparous women. In contrast, the same study found that primiparous women were less likely than multiparous women to have LBW babies [24]. Meanwhile, this study is not in agreement with a study done in five low and middle-income countries Democratic Republic of Congo (DRC), Guate mala, Belagavi, and Nagpur, India, and Pakistan whereby, nulliparous women had a lower chance of delivering an LBW as compared to those with parity of 4 and above $p<0.0001$ [25]. The discrepancy between these studies may be attributed to the difference in the sample.

According to this study, a neonate's weight is affected by where the woman lives. Women living in Unguja had a greater likelihood of having an LBW baby than those living in Mainland rural. It is reasonable to assume that people on the mainland and those on the island have different cultural norms. Besides that, the approach and attitude toward seeking healthcare differ, describing the disparity. The findings of this study contravene those of a study performed in the Amhara Region, Ethiopia, which found that women living in urban areas were less likely to give birth to an LBW baby than rural residents [26]. The disparity between the two studies is understandable given that women in rural areas are more likely to have limited access to healthcare, poorer nutrition, and higher rates of poverty, which would explain their high rate of LBW, as shown in the Ethiopian study.

Malaria being a common infection during pregnancy in some African regions is widely associated with low birth weight other than increasing neonatal mortality and morbidity rates. Surprisingly, this is not the case in this study as the present findings displayed no statistically significant relationship between receiving intermittent treatment for malaria and a neonate birth weight. These findings don't relatively match the findings of a topical review done in East Africa which indicated that malaria has a huge part in play for LBW with this effect mostly in areas with a high prevalence of malaria transmission [27]. The discrepancy between these findings may be due to the fact that the current study assessed if a pregnant woman ever took malaria preventive treatment at least once during pregnancy. Taking anti-malaria treatment at least once could have not played a protective measure against low birth weight.

Conclusion

This study found that the prevalence of low birth weight in Tanzania is 6.5%. Maternal factors associated with LBW were identified as age, number of antenatal visits, mother's parity, and place of residence. These findings necessitate measures to enhance child health and also highlights the importance of the government and policymakers focusing on preventing risk factors associated with LBW. Early identification of these risk factors, as well as high-quality ANC care, will help to reduce the burden of LBW.

Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
COR	Crude Odds Ratio
CI	Confidence Interval
DHS	Demographic Health Survey
HIV	Human Immunodeficiency Virus
LBW	Low Birth Weight
NIMR	National Institute for Medical Research
NBS	National Bureau of Statistics
OCGS	Office of Chief Government Statistician
TDHS-MIS	Tanzania Demographic and Health Survey and Malaria Indicator Survey
WHO	World Health Organization
ZAMREC	Zanzibar Medical Ethics and Research Committee

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Author contributions
G.L: Conceptualization and design, manuscript writing, editing, and revision. F.M: Drafted the manuscript, oversaw data cleaning and analysis, and provided additional information. All authors reviewed the final manuscript.

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Data availability
The datasets used during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study involved the analysis of secondary data Demographic and Health Survey and Malaria Indicator Survey (DHS-MIS). As a result, no official ethical approval was needed. Permission to use the data for this particular research and publishing in peer reviewed journal was obtained from DHS measures. The procedures for collecting DHS-MIS data, however, were approved by the following organizations: Tanzania's National Institute for Medical Research (NIMR), the Zanzibar Medical Ethics and Research Committee (ZAMREC), International's Institutional Review Board, and the Centers for Disease Control and Prevention in Atlanta, United States of America (USA). The participants' legal guardian/next of kin supplied written informed consent to participate in this study. All methods are carried out in accordance with relevant guidelines and regulation.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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