United Republic of Tanzania

MINISTRY OF HEALTH

NATIONAL MALARIA CONTROL PROGRAMME

The 2021 School Malaria and Nutrition Survey (SMNS) Report

Mainland Tanzania

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Abbreviations and Acronyms

°C	degrees Celsius
ACT	are artemisinin-based combination therapy
ALU	Artemether-lumefantrine
asl	above sea level
BMI	body mass index
CC	City Council
COVID-19	coronavirus disease 2019
DBS	dried blood spot
DC	District Council
DMFP	District Malaria Focal Person
EMC	End Malaria Council
g/dl	grams per decilitre
GPS	Global Positioning System
Hb	haemoglobin
ID	identification
IHI	Ifakara Health Institute
IRS	indoor residual spraying
ITN	insecticide-treated net
kg/m2	kilograms per square meter
km	kilometer
LLIN	long-lasting insecticide-treated net
LMIC	low- and middle-income country
m	meter
MAM	moderate acute malnutrition
MC	Municipal Council
MDA	mass drug administration
MIS	Malaria Indicator Survey
mm	millimeter
MoH	Ministry of Health
MRCC	Medical Research Coordinating Committee
mRDT	malaria rapid diagnostic test
MUAC	mid-upper arm circumference
MUHAS	Muhimbili University of Health and Allied Sciences

NAAIA-AHW	National Accelerated Action and Investment Agenda for Adolescent Health and Wellbeing
NIMR	National Institute for Medical Research
NMCP	National Malaria Control Programme
ODK	Open Data Kit
P.	Plasmodium
PI	principal investigator
PO-RALG	President's Office–Regional Administration and Local Government
QA/QC	quality assurance/quality control
RDT	rapid diagnostic test
SAC	school-aged children
SAM	severe acute malnutrition
SDG	Sustainable Development Goal
SFP	School Feeding Programme
SMNS	School Malaria and Nutrition Survey
SMPS	School Malaria Parasitaemia Survey
SNP	School Net Programme
SOP	standard operating procedures
SSA	sub-Saharan Africa
SUA	Sokoine University of Agriculture
TC	Town Council
TDHS-MIS	Tanzania Demographic and Health Survey and Malaria Indicator Survey
TFNC	Tanzania Food and Nutrition Centre
TNNS	Tanzania National Nutrition Survey
TV	television
U5	under 5 years of age
UDSM	University of Dar es Salaam
WHO	World Health Organization Executive Summar

Executive Summary

Background

Malaria, anaemia and malnutrition are still major health concerns amongst school age children (SAC), which affect their well-being and pose several challenges, including impaired cognitive functioning, school absenteeism and compromised educational outcomes. The School Malaria and Nutrition Survey (SMNS) provides data that monitors trends and changes in health risks at different geographical and malaria transmission zones in Tanzania. This serves as a unique platform that bridges information gaps experienced in other existing national representative surveys, such as the Tanzania Demographic and Health Survey and Malaria Indicator Survey and the Tanzania National Nutrition Survey (TNNS). The SMNS provides a platform for school surveillance in generating data that support evidence-driven decisions to further stratify interventions and design multi-sectoral programmatic intervention monitoring to address the observed burden and health challenges in schools. The 2021 SMNS objectives aimed to determine the prevalence of malaria, anaemia and malnutrition and their associated risk factors among SAC aged 5–16 years in Mainland Tanzania.

Methodology

The National Malaria Control Programme (NMCP) in collaboration with Nutrition section of the ministry of health, research and academia institutions conducted the cross-sectional survey among SAC aged 5–16 years in public primary schools across all 26 regions and 184 councils in Mainland Tanzania from September to November 2021. A total of 64,465 SAC from 650 randomly selected public primary schools were surveyed. The NMCP tested the SAC for malaria using malaria rapid diagnostic tests (mRDTs) and dried blood spots (DBS) were collected for molecular analysis and biochemical tests. Mid-upper arm circumference (MUAC) measurements were taken using MUAC tapes and, for one-third of the SAC tested, haemoglobin (Hb) concentration were measured using a HemoCue machine. Moreover, all SACs were interviewed to collect information on malaria knowledge, exposure to malaria messages, history of fever, treatment seeking and behaviour dietary intake. The NMCP also surveyed a sub-sample of 6,824 households linked to 10 percent of the interviewed SAC and heads of households were interviewed to collect socio-demographic data; household profiles, mosquito net ownership, access and use; exposure to malaria messages and housing conditions. Heads of schools were interviewed to collect information on the status of school feeding programmes and school health environments.

Key Findings

Malaria Prevalence

In the past 7 years, there has been a continued, remarkable declining trend of malaria prevalence among SAC, decreasing by nearly half from 21.6% in 2015 to 11.8% in 2021. The 2021 malaria prevalence varied by malaria epidemiological strata; from high strata (25.1%) to very low (0.1%). Prevalence was measured by elevation, geographical zone, regions, gender, and age.

In elevations below 750 meters (m) above sea level (asl), prevalence was 12.4%, whilst above 1750m asl, prevalence was 1.1%. The Southern and Lake zones recorded higher prevalence (22.5%), whilst the lowest was recorded in Central zone (0.6%). Across regions, the highest prevalence (38.5%) was recorded in Geita and the lowest (0.1%) in Arusha, Iringa, Kilimanjaro and Manyara. Boys had slightly higher malaria prevalence (12.9%) compared to girls (10.7%), whilst SAC older than 12 years had 16.5% prevalence, SAC aged 9-12 years were at 11.8%, and SAC aged 5–8 years were 9.5%. Almost one-third (30.9%) of the SAC who had a fever (≥37.5°C) had a malaria infection, compared to SAC with a normal body temperature (<37.5°C), of which 10.2% had a malaria infection.

Mosquito net ownership, access and use

The survey interviewed a total of 21,733 SAC to determine mosquito net ownership, of which 77.6% reported to own at least one mosquito net in their household. Of those who reported to own any mosquito net at home, 89.7% reported usually sleeping under mosquito net, whilst 86.4% reported to have slept under a mosquito net the night before the survey. Just over one-third (34.3%) of the total SAC interviewed reported having received mosquito nets at school. The proportion of households that owned at least one mosquito net was 83.5%, 50.3% of respondents noted that there was one net for every two people and 78.1% said they had access to insecticide-treated nets (ITN).

Malaria knowledge

Approximately two-thirds of the SAC interviewed (68.7%) were aware of at least one malaria preventive method. The regions with the highest proportion of knowledge on malaria prevention methods were Lindi (84.5%), Dar es Salaam (81.5%) and Katavi (80.6%), whilst the lowest were in Kilimanjaro (48.1%) and Rukwa (46.8%). Less than half (49.4%) of the SAC said they had been exposed to malaria prevention messages, but of those who had received prevention messages, radio was the most cited source of exposure, followed by schools (books and teachers) and television. Regions with a high proportion of SAC exposed to malaria messages were Pwani, Lindi, Tabora, Mara and Dar es Salaam, whilst Songwe, Rukwa, Iringa, Tanga and Kilimanjaro had the lowest proportions.

Anaemia

Overall, the prevalence of any type of anaemia among interviewed SAC was 31.9%; of which 0.7%, 17.0% and 14.2% had severe, moderate and mild anaemia respectively. More than half (51.3%) of SAC with anaemia had malaria infection. Further, SAC aged 15–16 years had the highest anaemia prevalence (54.8%) of any form, with girls demonstrating a a slightly higher prevalence of moderate anaemia (17.6%) compared to boys (12.9%). Regions located in high and moderate malaria epidemiological strata had high prevalence of anaemia. There was also a geographical heterogeneity in the distribution of anaemia across regions being highest in Pwani (56.5%), Simiyu (45.4%), Tabora (45.0%), Shinyanga (44.6%) and Mtwara (43.7%), while Manyara (12.7%), Kilimanjaro (12.1%) and Njombe (10.1%) recorded the lowest prevalence.

Nutrition status

The prevalence of acute malnutrition among SAC was 20.2%, of which 17.6% had moderate acute malnutrition (MAM) and 2.6% had severe acute malnutrition (SAM). The prevalence of both SAM and MAM increased with age, with a higher prevalence of MAM and SAM observed observed among SAC aged 15–16 years (48.4%). The regions with high prevalence of MAM and SAM observed were Manyara (41.9%), Simiyu (26.6%), Kigoma (25.5%), Kilimanjaro (25.4%), Singida (25.1%) and Geita (25.1%). Overall, overweight/obesity prevalence was 3.8%, with Lindi having the highest prevalence of SAC with overweight/obesity (9.7%), followed by Morogoro (9.2%) and Pwani (7.7%).

Dietary quality

Findings revealed that healthy food groups were mostly consumed more than four times per week by at least one-fifth of SAC. This included foods, such as liquid vegetable oil (35.2%), legumes (30.9%) and white roots and tubers (20.3%). The frequency of SAC consuming fish was low (14.5%) with notable differences reported across the regions. Consumption of unhealthy foods across all the regions was also reported, where 10.6% of all SAC reported consuming desserts more than four times per week, followed by fried foods bought outside the home (8.4%) and red meat (5.3%). SAC from Tanga (22.2%), Dar es Salaam (20.1%), Mtwara (18.2%), Katavi (16.9%) and Lindi (15.5%) consumed these foods more than four times per week compared to other regions.

School feeding programme

Overall, more than half (53.4%) of the visited primary schools did not implement a School Feeding Programme (SFP). Of the schools reported to have a SFP (n = 297), 98.2% reported providing meals to either all pupils, i.e. including special classes or children with special needs. The results show that 44% of the surveyed schools were surrounded by food vendors. The most available foods included fried foods (87.5%), sweet snacks (82.0%) and carbonated drinks containing sugar (70.5%). In addition, vegetables (salad, carrots, and cucumber), (52.1%), fruits (67.7%) and water (68.4%) were also available. Regions with the highest proportion of schools with a SFP were Njombe (94.1%), Kilimanjaro (93.3%) and Arusha (81.3%), while the lowest were Simiyu (10.5%), Dodoma (17.2%), Rukwa (17.6%), Kigoma (17.9%), Shinyanga (21.1%) and Katavi (25.0%). The majority (77.0%) of the schools reported low community participation as the main barrier to implementing SFP.

Conclusion

The prevalence of malaria, anaemia and acute malnutrition are still high among SAC in Mainland Tanzania. Malaria prevalence and anaemia coexist with marked variation across regions to the sub-council level. Further, there was high reported ownership and use of mosquito nets. The results also provide baseline data on SFPs and access to clean drinking water and sanitary facilities, wherein more than half of public primary schools lack these services. School-based intervention for malaria, anaemia and malnutrition should be targeted to all regions and epidemiological strata with high burden.

Chapter 1: Introduction

1.1 Background

Malaria remains a major global health problem despite unprecedented progress in its control for the past two decades. According to the World Health Organization (WHO), the coronavirus disease 2019 (COVID-19) pandemic overwhelmed global health systems and limited the provision of malaria services, resulting in marked increase of malaria cases and deaths (1). WHO estimates that there were 241 million malaria cases and 627,000 malaria deaths worldwide in 2020 compared to 227 million cases and 558 000 deaths in 2019 (1). This represents an increase of about 14 million cases and 69,000 more deaths from 2019 to 2020. Approximately two-thirds of these additional deaths (47,000) were linked to disruptions in the provision of malaria prevention, diagnosis, and treatment services during the COVID-19 pandemic (1).

Most of these cases and deaths occurred in sub-Saharan Africa (SSA), which accounts for about 95% of all malaria cases, 96% of all deaths (1). There is a need for better and more equitable access to health care services through strengthened primary health care and expanding domestic and international investments using innovative tools for malaria elimination, e.g. the RTS,S malaria vaccine for children in moderate to high *Plasmodium falciparum* (*Pf*) malaria transmission settings (2).

In Tanzania, recent evidence shows that malaria incidence rates have declined from 150 cases to 76 cases per 1,000 persons between 2015 and 2021 (3). Moreover, according to the Malaria Indicator Surveys (MIS), significant progress was made in reducing malaria infections by 50% in children under five years old, i.e. from 14.8% in 2015 to 7.3% in 2017 (4,5). On the other hand, biennial School Malaria Parasitological Surveys (SMPSs) conducted in mainland Tanzania between 2015 and 2019 showed a progressive decline in malaria prevalence: from 21.6% to 14.1% (6–9) respectively albeit with considerable heterogeneity. The observed malaria heterogeneity in the surveyed schools present similar pattern to other surveys and routine data from health facilities, which eventually divide the country into high and low malaria prevalence with central corridors (5,7). The observed reduction in malaria is partly contributed by joint efforts of various implementers and the latest initiative of tailoring control interventions based on epidemiological stratification. Interventions deployed in the country include provision of prompt diagnosis and treatment, long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS), and larval source management (10,11).

Although, malaria control efforts began over 130 years ago, the most success has been recorded in the last two decades, during which huge investment have been made by the country, leading to national scaling up of new preventive strategies and improved access to affordable and quality assured testing and treatment (12). Several national and global initiatives have shaped Tanzania's malaria control strategies over the years, including the sustainable development goals (SDGs) and the Roll Back Malaria (RBM) Partnership (13). Key national policies are in place to guide the National Malaria Control Programme (NMCP) on implementing its interventions in-line with the National Health Policy, National Strategy for Growth and Reduction of Poverty, Health

Sector Strategic Plan V and the ongoing Local Government Reform processes (14–17). The National Malaria Strategic Plan (2021–2025) aims to reduce the national average malaria prevalence in children under 5 (U5) years old from 7.3% in 2017 to less than 3.5% by 2025 (16) and achieve the global target of malaria elimination by 2030 (18).

Evidence has shown malaria, anaemia and malnutrition frequently coexist – particularly amongst children (22–24). Malaria, anaemia and malnutrition among school-aged children (SAC) is associated with impaired cognitive function, reduced ability to concentrate and learning in school, reduced academic achievement, school absenteeism and poor health conditions (22–24). However, most of the standard interventions and surveillance policies to address malaria, anaemia and malnutrition have targeted children U5 and pregnant women as the highest risk groups, while older children and adults (who are less often symptomatic do not receive sufficient attention (25). This policy gap needs to be addressed to optimise the successes in control interventions.

Malnutrition includes undernutrition (wasting, stunting, underweight), inadequate vitamins or minerals, overweight and obesity; all these conditions may lead to diet-related non-communicable diseases. Globally, more than 3,000 SAC die daily due to malnutrition, totalling 1.2 million deaths a year, largely from preventable causes (26). More than two-thirds of these deaths occur in low- and middle-income countries (LMICs) in Africa and Southeast Asia (27). In SSA, where 23% of the population is between 10 and 19 years of age, more than 50% of adolescents attending school present with micronutrient deficiencies, such as anaemia, primarily due to infections, such as malaria, food insecurity and limited food diversity (28). Moreover, 500 million school days are estimated to be lost due to illness each year across all LMICs, contributing to significant school dropout rates and hindering the development of human capital for economic development (29).

WHO aims for a world free of all forms of malnutrition, where all people achieve health and well-being. According to the 2016–2025 Global Nutrition Strategy, WHO works with member states and partners toward universal access to effective nutrition interventions and healthy diets from sustainable and resilient food systems (30). The Tanzania National Nutrition Survey (TNNS) provides information about pregnant women aged 15 to 49 years and malnutrition prevalence (stunting, wasting and underweight or overweight) among children U5 (31,32). However, there are paucity nutrition data for older children and adolescents.

Tanzania has expressed concern for the health and nutritional status of SAC through different interventions. The school feeding programme (SFP) was adopted to address nutrition and health problems, and thereby promote attendance and performance among SAC. SAC spend most of their time at school; hence, school settings are reliable targets to implement health programmes. Tanzania's Government launched the National School Feeding Guidelines in 2021 (33) and National Accelerated Action and Investment Agenda for Adolescent Health and Wellbeing (NAAIA-AHW) for 2021/22 – 2024/25 (34) with emphasis on improving nutrition of SAC and adolescents (35). However, there is limited data for SAC on the current school health environment, feeding practices and dietary quality of food consumed by these age groups.

1.2 Justification for the Study

The School Malaria and Nutrition Survey (SMNS), which is an expanded SMNS, is designed to increase the spectrum of malaria and nutrition status surveillance for SAC in Tanzania and provide more data points at sub-council levels for burden stratification. Schools are a reliable platform to reach SAC and track the progress for various interventions. According to the 2021 population projection, SAC constitute 30.9% of the total population in Mainland Tanzania (36). This age group is marked by significant physical and cognitive growth with broad implications on health throughout their life. The Tanzania universal primary education policy coupled with the observed high overall enrolment rate of 96.9% (37), offers a better opportunity to systematically collect key malaria and nutrition indicators among SAC. Indicators collected through this SMNS justify designing multi-sectoral programmatic interventions to address the observed burden and improve SAC's health challenges as schools provide a potential platform to reach SAC and track their progress on various interventions over time.

Furthermore, the SMNS provides dynamic recurrent data to monitor disease trends and changes in risk status. This serves as a unique platform that bridges information gaps experienced in other existing nationwide surveys, such as the Tanzania Demographic and Health Survey and Malaria Indicator Survey and the TNNS (4,5,31,32). Availability of SMNS data enhances NMCP's capacity to conduct council- and sub-council-level malaria stratification together with District Health Information System 2 (DHIS2) indicators (38). Also, along with MIS, the SMNS is the most important contributor to the modelled parasite prevalence risk mapping that is used for micro-stratification in the country. Hence, school surveillance is a novel approach for generating data that support evidence-driven decisions to further stratify interventions and design multi-sector programmatic interventions monitoring to address observed burdens and health challenges in communities (39–43).

1.3 Objectives

Overall Objective

The overarching objectives of the SMNS are to determine the prevalence of malaria, anaemia and malnutrition and their associated factors among primary SAC aged 5–16 years across regions, to the sub-council level, in Mainland Tanzania.

Specific Objectives

The SMNS has the following seven specific objectives:

1. Determine the prevalence of malaria infection among SAC (5 to 16 years) in Mainland Tanzania
2. Assess ownership and use of any mosquito nets among SAC in Mainland Tanzania
3. Assess knowledge of malaria among SAC (5 to 16 years) in Mainland Tanzania
4. Assess ownership, access, use, coverage and source of LLINs among surveyed households linked to the selected SAC
5. Determine the prevalence of anaemia in SAC (5 to 16 years) in Mainland Tanzania

6. Determine nutrition status among SAC (5 to 16 years) in public primary schools in Mainland Tanzania.
7. Assess the status of SFPs and school health environment in public primary schools in Mainland Tanzania.

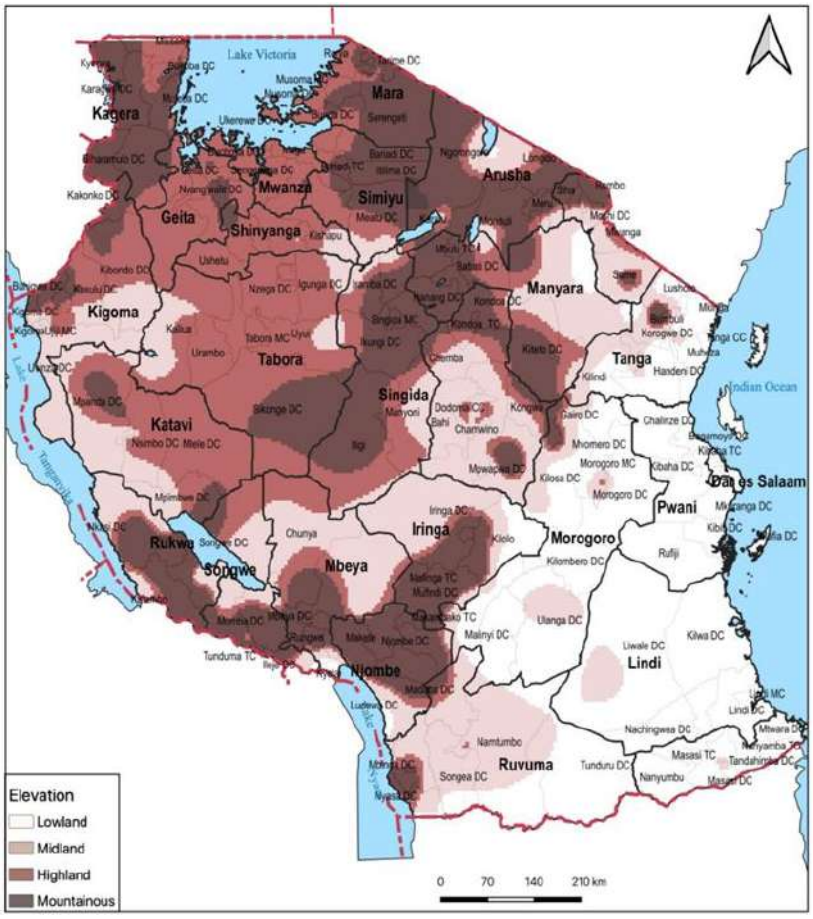
Chapter 2: Methodology

2.1 Study Area

Tanzania covers approximately 945,500km^2, of which 883,749km^2 is land area and 61,500 are inland water bodies with several lakes and rivers and coast along the Indian ocean. Tanzania lies between 1–12 degrees south of the equator and 29–41 degrees east (44). The country shares borders with eight countries: Kenya and Uganda to the north; Rwanda, Burundi, the Democratic Republic of Congo and Zambia to the west; and Malawi and Mozambique to the South. The Indian Ocean borders the country to the east. The 2021 projected population according to the 2012 national census was 57,724,380 whereby 17,833,205 (30.89%) are children aged between 5–16 years (36).

Tanzania is characterised by diverse and complex topographical features extending from a narrow coastal belt of the Indian Ocean with an extensive plateau and elevation ranging from 1,000 meters (m) to 2,000 m above sea level (asl). Country elevation has been categorised as lowland (less than 750 m asl), midland (between 750 and less than 1,250 m asl), highland (between 1,250 and 1,750 m asl) and mountainous (greater than 1,750 m asl), **Figure 1**.

Figure 1. A map of mainland Tanzania's elevation



Tanzania experiences unimodal and bimodal rainfall, depending on the location. The northern parts of the country, including areas around the Lake Victoria Basin, northern coast and areas around Mount Kilimanjaro experience bimodal rainfall; i.e. the first rainfall season occurs

between March and May and the second between October and December. Central, southern and western parts of Tanzania are characterised by unimodal rainfall that occurs between November and April. The temperature ranges between 10 and 20 degrees Celsius (°C) in the highlands and is usually higher than 20°C in the lowlands throughout the year. The hottest months are November to February, while the coldest are May to August (44).

Administratively, Mainland Tanzania consists of 26 regions and 184 councils. Regions are formed by several councils (i.e. an average of six to eight), which are either cities, municipalities, townships or rural (i.e. District Councils [DCs]). Councils are further subdivided into wards, which differ in numbers depending on the size of the council. Regions are grouped depending on their geographical proximity; when combined, they form zones. A zone comprises two to six regions; there are eight zones in Mainland Tanzania (44): Northern (Kilimanjaro, Tanga and Arusha), Western (Tabora and Kigoma), Southern (Lindi and Mtwara), Southwest Highlands (Mbeya, Rukwa, Katavi and Songwe), Eastern (Dar es Salaam, Pwani and Morogoro), Southern Highlands (Iringa, Njombe and Ruvuma), Lake (Kagera, Mwanza, Geita, Mara, Simiyu and Shinyanga) and Central (Dodoma, Singida, and Manyara).

The country is classified into four malaria epidemiological strata according to the malaria transmission risks at council level: very low, low, moderate and high malaria burden (38). This council-level classification aims to provide a more granular malaria burden definition potential for adoption and operationalization of different interventions.

2.2 Study Population and Eligibility

The study population were public primary schools and households in Mainland Tanzania. The target population were SAC 5–16 years and heads of households or representatives. All 26 regions and 184 councils in Mainland Tanzania were involved in the study. The following were used as sample inclusion criteria: (1) SAC aged 5–16 years, (2) children enroled in the public primary schools, (3) children whose parents or guardians allowed them to be included in the study and (4) consented household whose pupil(s) has been interviewed. The study excluded SAC who were not present at school or sick during the survey day.

2.3 Study Design

The SMNS was a cross-sectional survey designed to collect information from public primary SAC, head teachers and households linked to the selected SAC.

2.4 Sampling technique

The study covered all regions and councils of Mainland Tanzania. Each council was further stratified based on geographical characteristics, such as elevation and topography (low and highland areas), malaria prevalence, demographic status (urban vs rural), proximity (at least 30km apart) and population density (population size per km^2) to capture heterogeneity of malaria transmission and nutrition indicators. As several wards were scattered around stratum, one ward and a subsequent village/street hosting a school was randomly selected. Furthermore, one public primary school was selected in a single ward from each stratum due to financial resources and logistical reasons.

A multi-stage cluster sampling was used to select a representative school and, ultimately, SAC and households for the survey, as shown below.

- **Stage 1**. Random selection of representative wards from each stratum
- **Stage 2**. Random selection of representative schools from selected wards
- **Stage 3**. Random selection of SAC from the selected schools and random selection of 10% SAC for household visit

Children were selected systematically by using the school register. Researchers applied a 1:1 ratio for girls and boys from standards 1 through 6. Based on a proportional allocation to the primary school population size using a master pupil list from the President's Office – Regional Administration and Local Government (PO-RALG), each school was assigned a specific number of children to be sampled, ranging from a minimum of 60 to a maximum of 120. All selected SACs were tested for malaria and demographic information was collected. Of the SAC recruited, 33% were selected by random systematic sampling for interviews and measurement of haemoglobin (Hb) concentration. Additionally, systematic random sampling was used to select 10% of the interviewed SAC who were linked with their households. On the other hand, all selected public primary schools were visited to determine the status of the SFP and school health environment.

2.5 Sample size determination

The sample size was estimated at the council level based on council malaria prevalence estimates from the 2019 SMNS survey (unpublished), 0.05 margin of error, 5% significance level and a design effect of 2.5 to account for malaria transmission heterogeneity. The following formula was used to estimate council sample size (n_i):

$$n_i = \frac{Z^2_{1-\alpha/2} * P_i\,(1-P_i) * N_i * d}{{m_i}^2 * (N_i - 1) + P_i(1-P_i)}$$

Where:

n_i = sample size of ith council (i = 1, 2, 3, …,184)

$Z^2_{1-\alpha/2}$ = critical value of the standard normal distribution

P_i = Prevalence rate of the ith council

N_i = Population of children aged 5 – 16 years of the ith council

m_i =margin of error of the ith council

α = significance level (5%)

d = design effect (2.5)

The estimated council sample sizes (n_i) were aggregated to obtain a national sample. An estimated national sample of 65,500 SAC was computed, where 10% of this sample was used to estimate the number of households for the survey. A total of 6,500 households were estimated to participate in the household survey. In addition, 33% of the sampled SAC were

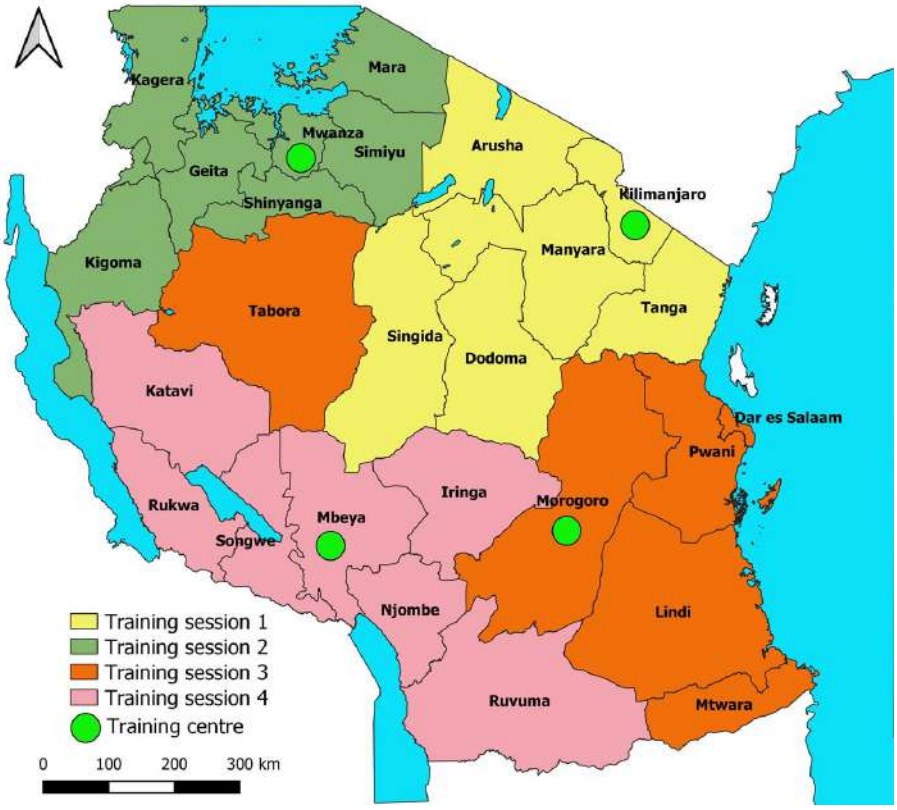
sampled to determine Hb concentration. The unit of analysis was public primary schools, SAC and households.

2.6 Study Procedures

Training Sessions

Four-day orientation workshops for field team and national supervisors were organised in the four designated training centres in Kilimanjaro, Mwanza, Morogoro and Mbeya (**Figure 2**). Teams comprised participants from 6 to 7 regions with members chosen, per team, based on their proximities and number of councils in the regions that allowed their full participation. The training covered; study protocol focusing on the survey objectives, fact sheet (**Annex 1**), Protocol for malaria testing and quality assurance and control (**Annex 2**), Malaria RDT standard operating procedures (**Annex 3**), fieldwork procedures, consenting produre (**Annex 4)** survey tools and quality assurance and quality check procedures (**Annex 5**), Hand over forms (**Annex 6**), use of Open Data Kit (ODK) for data collection and how to handle and manage data. Additionally, field teams were familiarised with survey tools by role playing on interviewing techniques and pre-testing of the tools. Under the guidance of the facilitators, council teams performed school sampling and calculated the sample size allocation.

Figure 2. The 2021 SMNS training session grouping, centres and field teams



Field work was conducted by national facilitators and supervisors, the regional and council field teams and drivers. National facilitators and national supervisors were drawn from the participating institutions: The Ministry of Health (MoH), NMCP, National Institute for Medical Research (NIMR), Ifakara Health Institute (IHI), National Bureau of Statistics (NBS), PO-RALG, Tanzania Food and Nutrition Centre (TFNC), University of Dar es Salaam (UDSM),

Muhimbili University of Health and Allied Sciences (MUHAS) and Sokoine University of Agriculture (SUA). A detailed list of the field teams, national facilitators, supervisors and investigating team is under **Annex 7**.

Council Teams

In each council, the data collection team comprised four members: District Malaria Focal Person (DMFP), School Health Coordinator (SHCo) from the Council Education Department and two laboratory technicians. The DMFP was responsible for overseeing the implementation of the SMNS in their respective councils. The SHCo was responsible for organizing a school committees' meeting and selecting and crafting message to be sent to parents of the selected SAC. In addition to the above responsibilities, both the DMFP and SHCo interviewed pupils, head teachers and personnel representatives of the households. The laboratory technicians were responsible for performing malaria tests and interpreting and recording results. They were also responsible to determine Hb levels and collecting dried blood spots (DBS) from SAC. In addition, two teachers from each participating school were identified by head teachers to work with the survey team on arranging selected SAC, recording SAC's identification number on the provided cards/tags and distributing refreshments.

2.7 Supervisors

National supervisors

National supervisors were officers and researchers from the MoH, PO-RALG, IHI, UDSM, NIMR, SUA, MUHAS and TFNC. Each national supervisor was assigned to supervise one region. They worked together with the regional team to perform a survey quality check and oversee survey implementation. National supervisors were also a bridge between their respective regions and councils, which they were supervising. In addition, at the end of the survey, national supervisors were responsible for collecting and compiling all documents, producing reports and return reports to the NMCP central office in Dodoma.

Regional supervisors

A Regional Malaria and Integrated Management of Childhood Illness Focal Person) and Regional Laboratory Technologist from each region were responsible for overseeing survey implementation and conducting quality checks at field sites.

2.8 Subject enrolment

Permission to enrol SAC for the survey in each selected school was obtained from parents/guardians by respective school committees. Children were selected by randomization – balanced to class and gender – prior to enrolment. Information on the study aim, benefits, risks and any anticipated harms were given to the selected children and adolescents. Additionally, a memo to inform their parents or guardians was provided. Uninterested parents or guardians were given a chance to opt the child out of the survey.

2.9 Laboratory work

A finger-prick blood sample was drawn from each SAC to determine the presence of malaria parasites on-site using the malaria Rapid Diagnostic Test (mRDT) (SD Bioline®); a proportion of the blood sample was collected on filter paper using dried blood spots (DBS) for further

molecular analysis. SAC who tested positive were given antimalarial drugs according to the National Malaria Diagnostic and Treatment Guidelines (45). We determined Hb concentration using a battery-operated portable HemoCue® analyser. Any SAC with an Hb concentration less than 8.0 grams per decilitre (g/dl) were referred to the nearby health facilities for further examination and care. Collected DBS were stored in resealable plastic bags with desiccants at the NMCP premises **(Annex 8)** for further analyses, including the determination of malaria parasite density and speciation, multiplicity of infection, parasite diversity and population genetic structure, resistance markers associated with partner drugs and artemisinin-based treatment, sickle cell traits, glucose-6-phosphatase dehydrogenase (G6PD) deficiency, determine undetectable/sub-microscopic parasitaemia and establish status of the parasite antigen histidine-rich protein 2/3 (HRP2/3) gene deletion.

2.10 School Health Environment and Feeding Programme

Researchers collected a range of components related to the school health environment and SFP among SAC aged 5–16 years in public primary schools in Mainland Tanzania, including school meals, school infrastructure, deworming, health and nutrition check-ups, school garden, nutrition clubs, micronutrient supplementation, entertainment/sports and physical activities (46). The overall assessment of the SFP aspects were availability, components available in the school, coordination, characteristics of school health infrastructure, beneficiaries, sources of food, types of food offered, availability of food vendors and general opinions among interviewed schools.

The survey assessed the availability of basic infrastructure for SFP implementation, including availability of clean and safe water, playgrounds, toilets, hand washing stations, food stores, dining halls and school kitchen.

2.11 Household information collected

The survey collected information on housing construction materials, including floor materials, ceiling, walls, roofs, space between roof and walls and protection on the windows.

Several variables and indicators were used to achieve the study objectives as indicated in **Table 1.**

Table 1: Summary of study indicators and variables

KEY INDICATORS AND VARIABLES
Demographic characteristics Age • Data were collected based on complete years • Three age groups were created to describe malaria metrics among SAC: 5–8 years, 9–12 years and 13–16 years • Groups were categorised basing on epidemiological and global standards • Based on WHO standards, three age groups were created for Hb measurements: 5–9 years, 10–14 years and 15-16 years Gender • Classified as girls and boys Body temperature • Classified as normal or fever • 37.5°C or higher was classified as having a fever; between 36.5°C and 37.4°C was classified as normal

Malaria epidemiological strata

- Mainland Tanzania has been classified as high, moderate, low and very low malaria epidemiological strata (38) with respect to the burden of malaria infection

Altitude

- Compare malaria prevalence between lowland and highland areas
- Adjustment of anaemia measurements according to altitude to account for a reduction in oxygen saturation of blood, adjusted based on this formula -0:032 * (altitude x 0:0032808) + (0:022 × (altitude x 0:0032808)^2
- Cut-off values for altitude were used to generate four classifications
  - lowland (less than 750 m asl)
  - midland (between 750 and 1,250 m asl)
  - highland (between 1,250 and 1,750 m asl)
  - mountainous (greater than 1,750 m asl)

Geographical zones

- Western (Kigoma and Tabora),
- Northern (Arusha, Kilimanjaro, and Tanga)
- Central (Dodoma, Manyara, and Singida)
- Southern highlands (Iringa, Njombe, and Ruvuma),
- Southern (Lindi and Mtwara),
- Southwest Highlands (Katavi, Mbeya, and Rukwa),
- Lake (Geita, Kagera, Mara, Mwanza, Shinyanga, and Simiyu),
- Eastern (Dar es Salaam, Morogoro, and Pwani)

Malaria prevalence

- Assess proportion of SAC with positive malaria test results against all SAC tested by mRDT
- The proportions presented as percentages (malaria prevalence)
- Malaria infections assessed against the following demographic variables: age groups, sex, epidemiological strata, geographical zones, regions, councils and elevation, fever, LLIN use and distance from school to nearest health facility

Knowledge of malaria prevention

- Knowledge of malaria prevention methods among adolescents aged between 9 and 16 years
- Proportion of SAC who mentioned at least one recommended preventive method

Exposure to malaria messages

- Questions asked on hearing or seeing malaria prevention, testing and treatment messages
- SACs were asked to describe the sources of malaria information
- Proportion of SAC who mentioned at least one of the recommended sources of malaria information

Mosquito net ownership and use

- Proportion of SAC who reported at least one mosquito net at their home or in their family
- Number of children who reported at least one mosquito net against all interviewed
- Assessment of LLIN ownership relatively to any other mosquito net
- Proportion of households with at least one insecticide-treated net (ITN)
- Proportion of households with at least one ITN for every two people
- Proportion of population with access to an ITN in their household

Knowledge of malaria transmission

- Proportion of SAC who were aware of vector transmitting malaria

Knowledge of recommended antimalarial drug

- Proportion of children who mentioned recommended malaria drug

Anaemia

- Hb level was determined in one-third of the sampled SAC
- Severity of anaemia defined based on WHO cut-off points
- Proportion of SAC with any mild, moderate or severe anaemia

ANAEMIA STATUS	HB LEVEL (G/DL)		
	CHILDREN/ADOLESCENTS AGED 5–11 YEARS	CHILDREN/ADOLESCENTS AGED 12–14	ADOLESCENTS AGED >15 YEARS
Any anaemia	<11.5	<12.0	Girls: <12.0 Boys: <13.0

Mild	11.0–11.4	11.0–11.9	Girls: <11.0–11.9
			Boys: <11.0– 12.9
Moderate	8.0–10.9	8.0–10.9	8.0–10.9
Severe	<8.0	<8.0	<8.0

Dietary quality

- Assessed using a standardised questionnaire of Prime Diet Quality Score (PDQS)
- Questionnaire containing 21 food groups, which were recategorised as healthy and unhealthy
- Responses on how often a SAC consumed a food were grouped in to 5 categories:
  - Not at all
  - Once a week
  - Twice to three times a week
  - Four to five times a week
  - Six or more times a week

Dietary quality of food groups was assigned based on whether the food was categorised as healthy or unhealthy

For healthy food groups

- A zero score represents 0–1 servings/week
- One-point score represents 2–3 servings/week
- Two-point score represents ≥4 servings/week

For unhealthy food groups

- A zero score represents ≥4 servings/week
- One-point score represents 2–3 servings/week
- Two-point score represent 0–1 servings/week

Unhealthy foods groups

- Red meat
- Processed meat
- Refined grains and baked goods
- Sugar sweetened beverages (soft drinks, energy drinks and fruit drinks with added sugar)
- Fried foods obtained away from home (fried cassava, French fries and chicken nuggets)
- Desserts (candy, chocolate, cookie, ice cream and cake)

Healthy food groups

- Cruciferous vegetables (cabbage, broccoli, sprouts and cauliflower)
- Dark leafy green vegetables (amaranth, cassava leaves and pumpkin leaves)
- Eggs
- Fish (Nile perch, sardine, tuna and tilapia)
- Legumes (beans, cowpeas, pigeon peas, lentils, Bambara nuts and green gram)
- Liquid vegetable oil (sunflower oil, corn oil, olive oil and sesame, cottonseed)
- Low fat dairy (fresh milk, yoghurt, cheese and ghee, butter)
- Nuts (groundnut, walnut, cashew and almond)
- Dark orange fruits and vegetables (carrot, pumpkin, beetroot, mango and papaya)
- Other vegetables (eggplant or African eggplant, okra, cucumber and zucchini)
- Poultry (chicken, turkey, duck and pigeon)
- Citrus fruits (orange, lemon, grapefruit, tangerine, lime and grapefruit)
- Other fruits (avocado, pineapple, guava, tamarin and baobab)
- Whole grains (unrefined corn, millet, wheat, rice and their products)
- White roots and tubers (cassava, plantain, banana, yams and potato)

Anthropometric measurements (Mid Upper Arm Circumference [MUAC])

- MUAC was used to identify nutrition status
- Measured on the bare arm of each student halfway between the tip of the elbow and the tip of the shoulder
- Nutrition status was categorised as
  - Severe acute malnutrition to those who were severely thin,
  - Moderate acute malnutrition for those identified thin (undernutrition),
  - Normal and overweight and obesity for those indicated extra body fat (overnutrition) on their arms

Specific MUAC cut-off points

GROUP	SEVERE ACUTE MALNUTRITION (*SEVERE THINNESS*)	MODERATE ACUTE MALNUTRITION (MODERATELY *THIN*)	NORMAL NUTRITION STATUS	OVERWEIGHT/ OBESITY
Children 5–9 years	<13.5 cm	≥13.5 to <14.5 cm	≥14.5 to ≤23 cm	>23 cm
Early adolescents 10–14 years	<16.0 cm	≥16.0 to <18.5 cm	≥18.5 to ≤25 cm	>25 cm
Late Adolescents 15–16 years	<18.5 cm	≥18.5 to < 22	≥22.0 to ≤ 28.0 cm	>28 cm

SFP

This indicator was assessed through the following components using a questionnaire:

- School health infrastructure
- Coordination
- Source of food
- Type of food
- Beneficiaries
- School teachersc opinion about SFP
- Availability of food vendors around the surveyed schools

2.12 Data Collection Tools

The following tools were used in the survey

- council general Information (tool 1)
- designated register for malaria tests (tool 2)
- Hb determination and DBS collection
- individual questionnaire (tool 3)
- household questionnaire (tool 4)
- school nutrition and environment (tool 5)
- anti-malarial medicines provision form (tool 6).

In addition, researchers used smartphones/tablets with ODK, a HemoCue® machine and microcuvettes, thermometers, Pan/pf mRDTs, MUAC tapes and 3-millimeter (mm) Whatman® chromatographical filter papers, powder free gloves and anti-malarial drugs for SAC who tested positive for malaria (**Annex 4**).

Electronic Data Capturing

A mobile data collection application known as ODK was used to customise tools in the electronic format. Logical checking functions were programmed to restrict the type of data and their ranges. This study captured a wide range of data, such as continuous, discrete and categorical data from 64,465 SAC, 6,500 households and 650 head teachers. The ODK promoted validation rules to control typos, out of range values, incorrect values, incompleteness and timely monitoring of field data. The data accuracy was improved by using the mobile application more extensively than the conventional hard copy forms used in

previous surveys. This indicates the potential for increasing the accuracy of data capturing with the aid of mobile data capture applications.

Pre-Testing of Data Collection Tools

We pre-tested data collection tools during orientation workshop sessions. The aim was to familiarise users with the tools, determine the tools' applicability, check for consistency among the tools and estimate the time it would take to conduct an interview. Pre-testing was conducted for at least 30 SACs from selected primary schools and 10 households from the community to improve the tools.

2.13 Data Management

Data entry

An electronic data capture system using ODK, linked to the national server, was established in all forms (except designated register). Data in the hardcopy tools were entered in ODK at the central level by trained data clerks who were guided and monitored by a data entry supervisor All questions regarding the task raised by data clerks were clarified by the supervisor(s) and principal investigator. Moreover, confidentiality of data was highly emphasised and participants were advised to cross-check their work before sending data to the server, as per the SOP. A detailed data entry report is attached as **Annex 8**.

Data cleaning

Data cleaning involved checking for data completeness, duplication and integrity of data values from tool 1 to tool 6 by a well-trained team of statisticians. All data were cleaned using STATA software. Also, structural errors, unwanted outliers and data missing were all fixed. For more detail refer to **Annex 8**.

DBS samples were sorted, labelled, arranged and repacked according to mRDT results, respective schools, councils and regions. All missing, contaminated, duplicated, and unlabelled DBS were identified and packed separately. For more detail refer to **Annex 8**.

Data Analysis

Data were analysed using STATA software version 14. The units of analysis were public primary schools, school children aged 5–16 years and households. Descriptive analysis (e.g. percentage, mean, maximum, minimum and frequency) was used to summarise numeric and categorical variables. Results of analysis were presented in tabular form, graphical (e.g. bar and pie charts) and council and region maps. Locations of sampled schools, malaria prevalence, anaemia prevalence, mosquito net access, ownership and use and nutrition indices were generated using QGIS 3.10 software.

The prevalence of malaria, anaemia and malnutrition among SAC was aggregated to obtain school, council, region estimates and national estimates. SFP indicators were assessed at the school level, whilst those for households were estimated at household and individual level, for instance, coverage and population access to mosquito net, respectively.

The study variables and indicators are as described in (**Table 1**). Descriptive statistics were shown in tables and charts describing prevalence of each indicator by demographic characteristics. Tables, charts and maps were used to present the output results for each

respective variable. The results for malaria prevalence were presented in maps showing regional profile with associated population density, altitude and climatic condition. Maps were also used to present the percentage of malaria prevention methods, awareness on vector transmitting malaria and treatment, mosquito net ownership and coverage and knowledge on malaria treatment methods. Tables and charts were used to describe the prevalence of each indicator by age, sex, geographical zones, education level of parents and child class. In addition, bar charts were created to present the trend of malaria prevalence among children over the survey rounds across epidemiological age groups and geographical zones.

The prevalence of anaemia was presented by showing the proportion of Hb level, based on the cut-off points by age categories and the levels of anaemia (any anaemia, severe, moderate and mild; **Table 1**). Maps, bar charts and tables were used to illustrate nutrition status of SAC, whereby the interpretation was made following the MUAC measurements using the specific cut-off points for a specific age group category (**Table 1**). Following the MUAC measures, the proportion of severe, moderate and obesity/overweight malnutrition across background characteristics was presented based on the specific age group.

Data rights, availability, ownership and access

The MoH, through the NMCP, is the primary owner of SMNS data and is accountable for ensuring data storage, security and safety. Data access requestor can send to the Permanent Secretary MoH through the NMCP. All rights over the documents, notes, paper, records and other publications of any nature in any materials produced under the provisions or in execution of the SMNS are protected by the copyright laws of the United Republic of Tanzania and shall be vested by the MoH through the NMCP. The requestor shall entail in a 1-page concept note reason for the request, type and data level, and a significant contribution in the scientific community and country at large will be made with requested data. More details on data availability, ownership and access can be found in **Annex 9.**

2.15 Ethical Considerations

Ethical clearance certificate number NIMR/HQ/R.8c/Vol.I/1857 was obtained from the National Health Research Ethics Committee, a sub-committee of the Medical Research Coordinating Committee (MRCC) of NIMR (NIMR – MRCC) before implementing this survey. As the study was conducted with individuals under 18 years of age and involved taking blood samples, strict measures were taken to ensure participants' protection. The principal investigator and some of the co-investigators attended a workshop and obtained a certificate in human subject protection. Other co-investigators and field staff were trained by Pi and personnel from ethical committee to ensure human subject protection. As stakeholders, PO-RALG, Ministry of Education, Science and Technology, Council Health Management Team and the education units at the respective localities were involved in various stages.

Each school committee gave consent for the school's involvement in the study. Parents/guardians of the selected children were informed through the school committee by a written memo and were allowed to their child out of participating in the study. Children's verbal assent was also considered for their participation. The head of household/representative was consented for their household's participation in the interview (**Annex 4**).

Chapter 3: Results

3.1 Demographic Characteristics

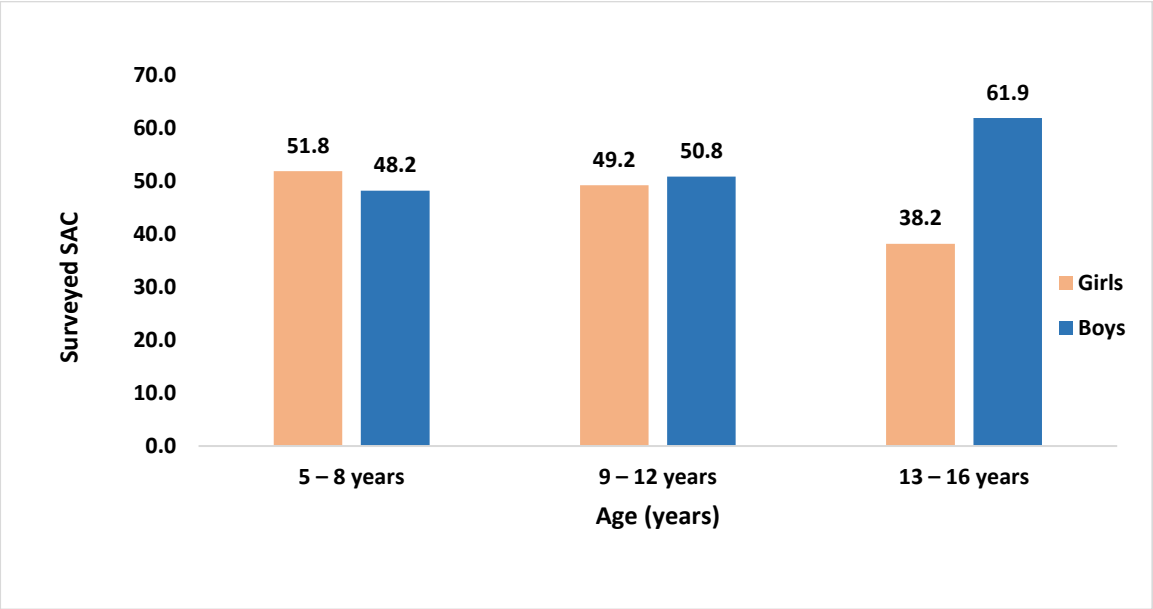
School characteristics

A total of 650 public primary schools were surveyed in all 26 regions and 184 councils in Mainland Tanzania. Due to Dar es Salaam's population density, it provided the highest number of schools surveyed (n = 52), while Katavi had the lowest number of schools (n = 12). A detailed summary of the number of schools surveyed by region is presented in **Table 2.**

SAC characteristics

A total of 64,465 school aged children were surveyed, of which 32,301 (50.1%) were girls and 32,164 (49.9%) were boys. On average, 100 SAC per school were surveyed, ranging from 53 to 143. The age distribution of surveyed SAC was as follows: 31.4% were 5–8 years old, 52.8% were 9–12 years old and 15.8% were13 – 16 years old. The mean age of all surveyed SAC was 10 years, ranging from 5 to 16 years. Half of the SAC (50.4%) came from schools that are located within 5 kilometres (km) or less from a health facility (**Table 2)**.

Figure 3. Surveyed SAC by age group and gender



Of the total participants (64,465), the distribution of the SAC according to elevation ranged from 5% (1,750m asl) to 36.1% (750m–1250m asl). On the other hand, the majority of surveyed SAC (36.5%) were sampled from the high malaria epidemiological strata while 24.2% were from low, 22.8% were from moderate and 16.5% were sampled from the very low epidemiological strata (**Figure 4** and **Table 3**). The distribution of SAC according to geographical zones ranged from 5.7% in Southern to 24.3% in Lake Zone (**Figure 6**). Finally, the distribution of SAC by region ranged from 1.9% in Katavi to 8.8% in Dar es Salaam (**Table 3**).

Table 2: Summary of surveyed public primary schools and SAC by region

REGION	NUMBER OF COUNCILS	SAC PER COUNCIL			NUMBER OF SCHOOLS	SAC PER SCHOOL			SAC AGE		
		AVERAGE	MIN	MAX		AVERAGE	MIN	MAX	AVERAGE	MIN	MAX
Arusha	7	431	278	711	32	94	54	120	10.2	5	16.6
Dar es Salaam	5	1063	407	1986	52	102	71	120	10.1	5	16.9
Dodoma	8	354	191	599	29	98	60	120	10.8	5	16.8
Geita	6	385	291	608	23	100	76	120	10.7	5	16.7
Iringa	5	322	201	415	16	101	71	120	9.8	5.1	16.7
Kagera	8	416	306	827	34	98	69	120	10.6	5	16.8
Katavi	5	240	203	297	12	100	82	120	10.5	5	16.9
Kigoma	8	357	202	499	28	102	68	132	10.5	5.3	16.9
Kilimanjaro	7	419	204	853	30	98	79	120	9.8	5	16.7
Lindi	6	237	196	334	14	102	72	122	10.4	5.1	16.8
Manyara	7	412	283	610	29	99	71	120	10.7	5	16.7
Mara	9	300	189	407	28	96	59	118	10.5	5.3	16.6
Mbeya	7	304	198	527	21	101	83	120	9.8	5	16.5
Morogoro	9	356	182	575	32	100	69	121	10.4	5.2	16.7
Mtwara	9	249	192	402	22	102	81	120	10.1	5.3	16.8
Mwanza	8	445	295	748	36	99	60	120	10.6	5.1	16.9
Njombe	6	288	204	311	17	101	83	120	9.9	5.2	16.7
Pwani	9	224	180	308	20	100	69	120	10.4	5.5	16.8
Rukwa	4	426	300	582	17	100	83	120	10.5	5	16.8
Ruvuma	8	285	186	372	24	95	70	119	10.1	5.2	16.7
Shinyanga	6	311	197	384	19	98	71	126	10.6	5.1	16.9
Simiyu	6	316	203	402	19	100	84	119	10.9	5	16.8
Singida	7	284	196	407	20	99	72	143	10.7	5.1	16.8
Songwe	5	283	204	413	14	101	69	120	10	5.4	16.7
Tabora	8	401	198	615	32	100	58	120	10.6	5.2	16.8
Tanga	11	263	186	404	30	96	71	120	10.4	5	16.9
Total	**184**	**350**	**180**	**1986**	**650**	**100**	**54**	**143**	**10.4**	**5**	**16.9**

Figure 4. Surveyed SAC by age groups and malaria epidemiological strata

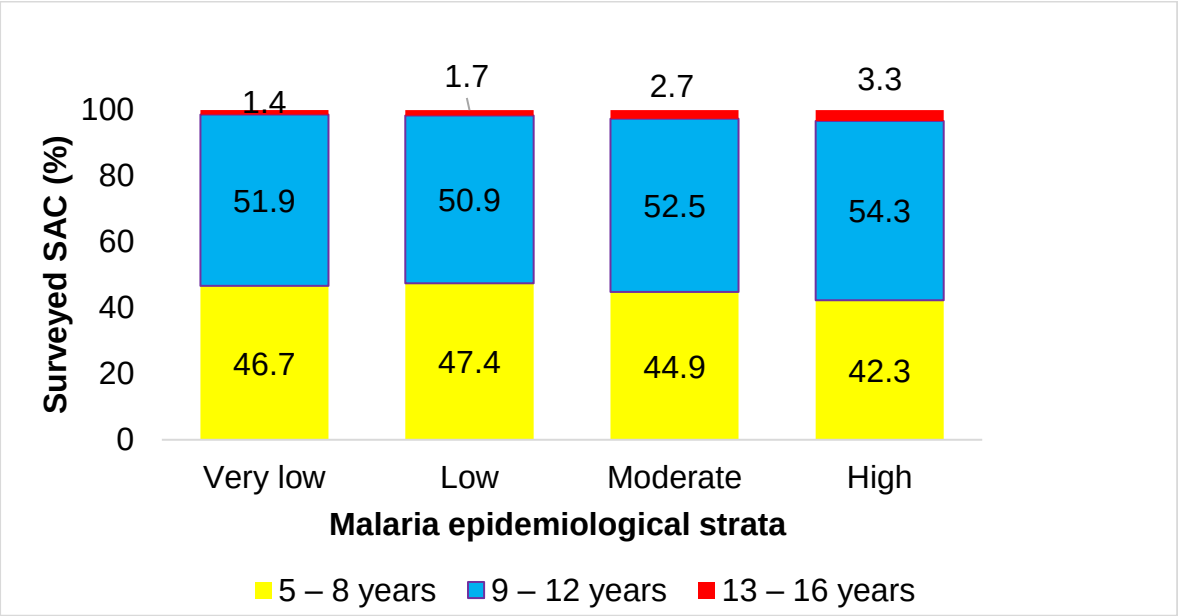
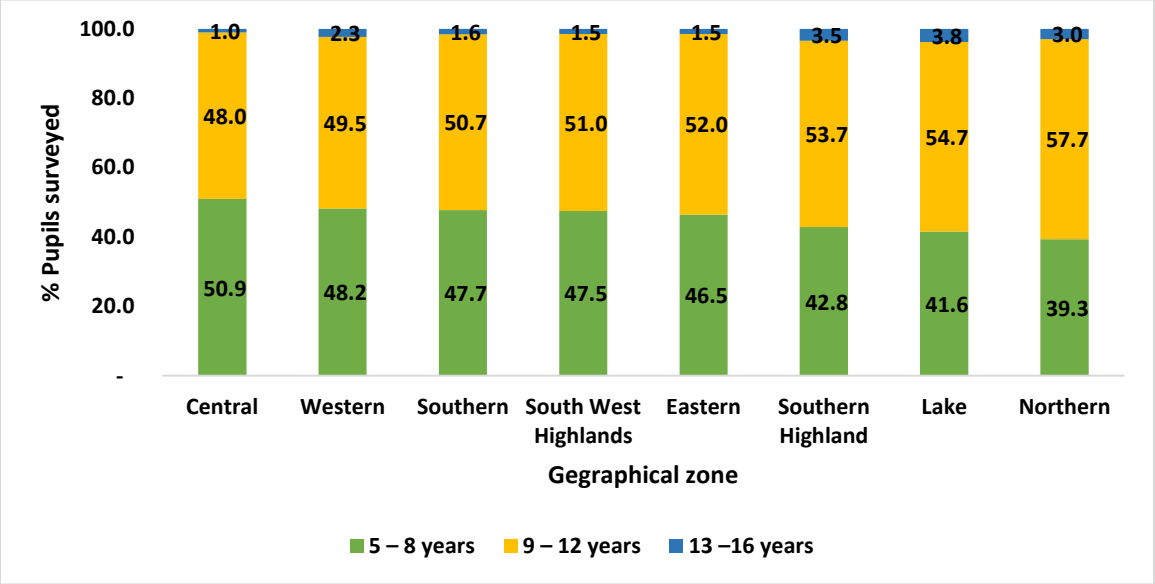


Table 3: Distribution of selected SAC

BACKGROUND CHARACTERISTICS	PERCENTAGE	NUMBER OF PARTICIPANTS
Gender		
Girls	50.1	32,301
Boys	49.9	32,164
Age (years)		
5–8	31.4	20,196
9–12	52.8	34,018
13–16	15.8	10,166
Distance of the school from the nearby health facility		
Within 5 km	49.6	31,949
5 km or more	50.4	32,516
Elevation		
Below 750m asl	32.2	20,767
750m–1,250m asl	36.1	23,233
1,250–1,750m asl	26.7	17,214
Above 1,750m asl	5.0	3,251
Malaria Epidemiological strata		
Very low	16.5	10,633
Low	24.2	15,618
Moderate	22.8	14,684
High	36.5	23,530
Geographical zone		
Central	11.9	7,697
Eastern	16.3	10,519
Lake	24.3	15,637
Northern	13.7	8,833

BACKGROUND CHARACTERISTICS	PERCENTAGE	NUMBER OF PARTICIPANTS
Southern Highlands	8.7	5,614
Southwest Highlands	10.0	6,443
Southern	5.7	3,661
Western	9.4	6,061
Region		
Arusha	4.7	3,016
Dar es Salaam	8.2	5,307
Dodoma	4.4	2,831
Geita	3.6	2,309
Iringa	2.5	1,610
Kagera	5.2	3,325
Katavi	1.9	1,200
Kigoma	4.4	2,856
Kilimanjaro	4.6	2,932
Lindi	2.2	1,421
Manyara	4.5	2,880
Mara	4.2	2,696
Mbeya	3.3	2,124
Morogoro	5.0	3,204
Mtwara	3.5	2,240
Mwanza	5.5	3,553
Njombe	2.7	1,724
Pwani	3.1	2,008
Rukwa	2.6	1,704
Ruvuma	3.5	2,280
Shinyanga	2.9	1,862
Simiyu	2.9	1,892
Singida	3.1	1,986
Songwe	2.2	1,415
Tabora	5.0	3,205
Tanga	4.5	2,885

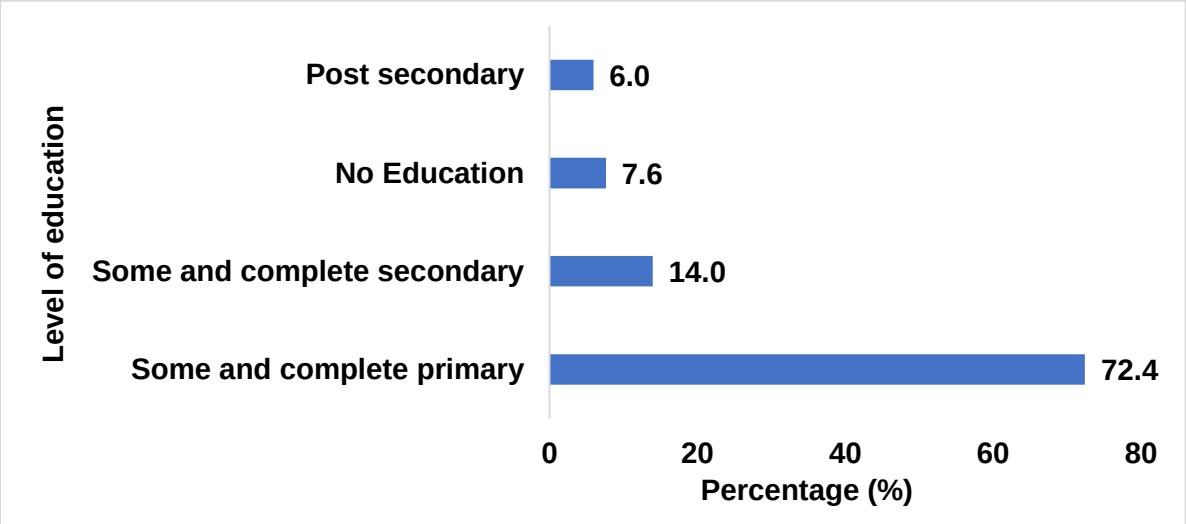
Figure 5: Surveyed SAC by age group and geographical zones



Characteristics of surveyed households and household respondents

A total of 6,824 households linked to the 10% of the SAC enrolled in the survey were selected for interview using the household questionnaire (**Annex 5)**. A majority (72.4%), of the household respondents reported receiving some education or a complete primary education, followed by 14.0% who had some or complete secondary or higher education. Only 6.0% of the households' respondents had post-secondary education, whlist 7.6% had no education **(Figure 6).**

Figure 6. Educational levels among surveyed households' respondents



Of the 6,824 households' respondents interviewed, 79.4% were married and 2.5 % were unmarried (**Table 4**). The distribution of the surveyed households according to malaria epidemiological strata were 35.2% (high), 24% (moderate), 24% (low) and 16.8% (very low). The distribution of households according to geographical zone ranged from 5.5% in the Southern zone to 23.6% in Lake zone. The distribution of the households by region ranged from 8.1% in Dar es Salaam to 1.8% in Katavi (**Table 4**).

Table 4: Distribution of household heads

BACKGROUNDS	PERCENTAGE OF HOUSEHOLDS	NUMBER OF HOUSEHOLDS
Highest level of education of the household head		
No education	7.6	522
Incomplete primary education	5.7	386
Completed primary education	65.7	4,485
Incomplete secondary education	1.1	72
Training after secondary education	3.5	237
Secondary or higher	16.4	1,122
Marital status of the household head		
Married	79.4	5,418
Unmarried	2.5	172
Widow/widower	7.3	500
Separated	5.3	364
Cohabiting	5.3	360
Malaria epidemiological strata		
Very low	16.8	1,138
Low	24.0	1,625
Moderate	24.0	1,621
Very high	35.2	2,378
Geographical zone		
Central	11.5	787
Eastern	16.3	1,109
Lake	23.6	1,612
Northern	13.7	934
Southern Highlands	8.8	601
Southwest Highlands	11.4	781
Southern	5.5	376
Western	9.1	624
Region		
Arusha	4.9	331
Dar es Salaam	8.1	551
Dodoma	4.2	287
Geita	3.5	239
Iringa	2.5	174
Kagera	5.1	346
Katavi	1.8	126
Kigoma	4.2	288
Kilimanjaro	4.4	300
Lindi	2.1	146
Manyara	4.4	297
Mara	4.0	276
Mbeya	3.2	215
Morogoro	5.1	349
Mtwara	3.4	230

BACKGROUNDS	PERCENTAGE OF HOUSEHOLDS	NUMBER OF HOUSEHOLDS
Mwanza	5.4	369
Njombe	2.8	190
Pwani	3.1	209
Rukwa	4.0	272
Ruvuma	3.5	237
Shinyanga	2.7	186
Simiyu	2.9	196
Singida	3.0	203
Songwe	2.5	168
Tabora	4.9	336
Tanga	4.4	303
Total	100	6,824

Results demonstrate that most of the house floors were constructed using cement (48.7%) followed by mud/sand (47.1%). A majority of the houses were unsealed (74.7%). The wall construction varied from concrete blocks (15.1%) to burnt mud bricks (33.3%) and unburnt mud bricks (18.9%); the other type of wall construction materials varied from 0.4% to 9.9% **(Table 5).** Most of the surveyed houses had roofs made of iron sheets (87.2%). Other observed roofing materials were mud, grass, bamboo sticks, plastic papers, asbestos and concrete or cement. A majority of the houses had closed eaves (72%), whilst 20.1% had open and 7.8% had partially closed eaves. Window materials ranged from wood (37.9%) to plastics (5.1%), some of which had wire screens (55.3%); 28.2% were unscreened. Other window screening materials such as bed nets and plastics were observed (**Table 5).**

Table 5: Percentage distribution of households by construction material

HOUSING CHARACTERISTICS	HOUSEHOLDS	PERCENT
Floor material		
Ceramic tiles	186	2.7
Hardwood	40	0.6
Cement	3,325	48.7
Mud or sand	3,214	47.1
Animal dung	25	0.4
other	34	0.5
Ceiling materials		
Traditional ceiling	122	1.8
Gypsum board	335	4.9
Board wood	1,073	15.7
Cement	56	0.8
Wood	67	1.0
Unsealed	5,098	74.7
Other	73	1.1
Wall materials		
Iron sheet	106	1.6
Concrete blocks	1,029	15.1

HOUSING CHARACTERISTICS	HOUSEHOLDS	PERCENT
Burnt mud bricks	2,273	33.3
Unburnt mud bricks	1,293	18.9
Stone cement	364	5.3
Stone mud	676	9.9
Concrete	499	7.3
Bamboo mud	318	4.7
Poles, palm trees, logs, bamboo	151	2.2
Grass	29	0.4
Wood	61	0.9
Others	25	0.4
Roofing material		
Iron sheet	5,950	87.2
Mud	118	1.7
Grass	539	7.9
Bamboo stick	100	1.5
Plastic papers	4	0.1
asbestos	11	0.2
Bamboo	10	0.1
Concrete/cement	52	0.8
Others	40	0.6
Space between roof and walls		
Eaves partially closed	532	7.8
Open eaves	1,366	20.1
Closed eaves	4,891	72.0
Window material		
Iron sheet	541	7.9
Wood	2,587	37.9
Plastics	351	5.1
Glasses	928	13.6
Screened	1,548	22.7
Other	869	12.7
Protective gear on the window		
Used bed net	51	0.7
Not screened	1,926	28.2
Plastics	296	4.3
Wire screen	3,771	55.3
Other	780	11.4
Total	6,824	100

3.2 Malaria prevalence

Of the 64,465 SACs aged 5–16 years tested, a total of 7,618 had positive malaria test results, indicating an overall malaria prevalence of 11.8% (**Table 6**). The results varied across background characteristics (age, place of residence, gender of a child, altitude), malaria epidemiological strata, regions, geographical zones and councils, as described in **Table 6**.

Age and gender

The highest malaria prevalence (16.5%) was observed amongst older SAC aged 13–16 years and the lowest (9.5%) amongst SAC below 9 years of age. This indicates that malaria prevalence was higher among the older age group compared to the younger age group. Results further revealed boys to have higher malaria prevalence (12.9%) compared to girls (10.7%) (**Table 6**).

Fever

Among the surveyed SAC, a total of 4,993 (7.75%) had a fever (≥37.5°C) on the day of the survey; of these 1,542 (30.9%) had malaria infection, whilst 10.2% (6,076) of those who had normal body temperature (no fever) had malaria infection (**Table 6**). Overall, 79.7% of SAC had asymptomatic malaria infection.

Mosquito net ownership and use

Of the 16,863 SAC who reported having a mosquito net at home, 2,134 (12.7%) had malaria positive results. Also, of the 14,585 SAC who reported sleeping under a mosquito net the night before the survey, 12.1% had malaria positive test results (**Table 6)**.

Distance of the school to the nearest health facility

A total of 4,545 SAC whose schools were more than 5km from nearby health facilities had higher malaria prevalence (14%) compared to 3,073 (9.6%) SAC whose schools were within 5km of the nearby facilities.

Elevation

Malaria infection was more prevalent (15.3%) in midland (750 – 1,250m asl), compared to the 1% prevalence in mountainous areas (greater than 1,750m asl) (**Table 6)**.

Malaria epidemiological strata

In this survey, malaria prevalence was found to be highest (25.1%) in areas with high malaria epidemiological strata and lowest (0.1%) in very low malaria epidemiological strata (**Table 6)**.

Geographical zones

The Lake and Southern zones were found to have highest proportion (22.5%) of SAC with malaria infection followed by the Western zone (19.8%). The Central zone had the lowest malaria prevalence (0.6%).

Regions

Malaria prevalence varied across regions, the highest prevalence (39.6%) was recorded in Geita and the lowest (0.1%) in Iringa and Njombe regions. Out of the 26 regions of Mainland Tanzania, 38.5% (10/26) regions recorded a malaria prevalence of less than 10.0%, 57.7%

(15/26) regions recorded malaria prevalence ranging between 10.0% and 30.0% and 3.8% (1/26) region recorded malaria prevalence above 30% (Figure 7).

Figure 7. Malaria prevalence in SAC aged 5–16 years, by region

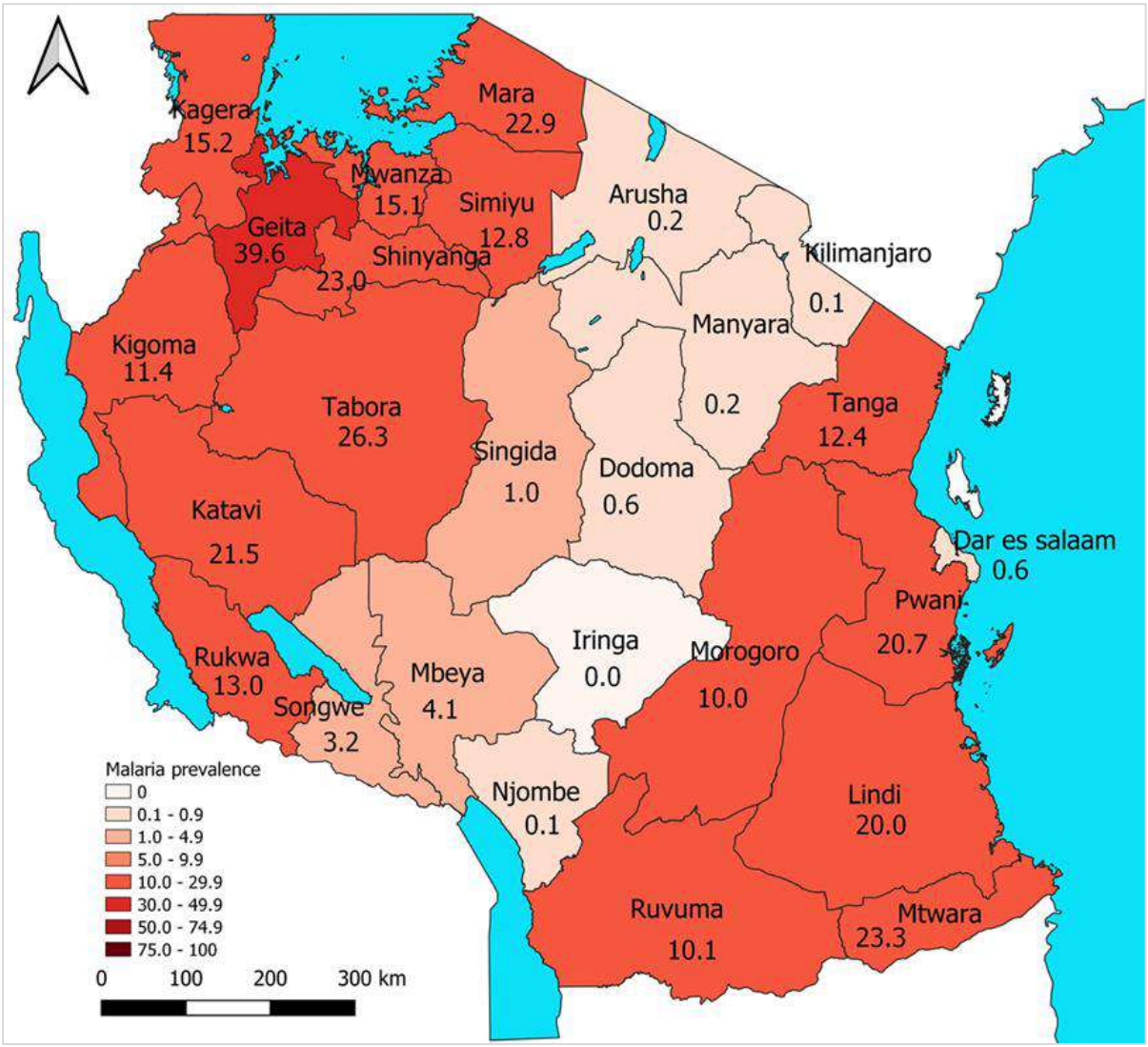
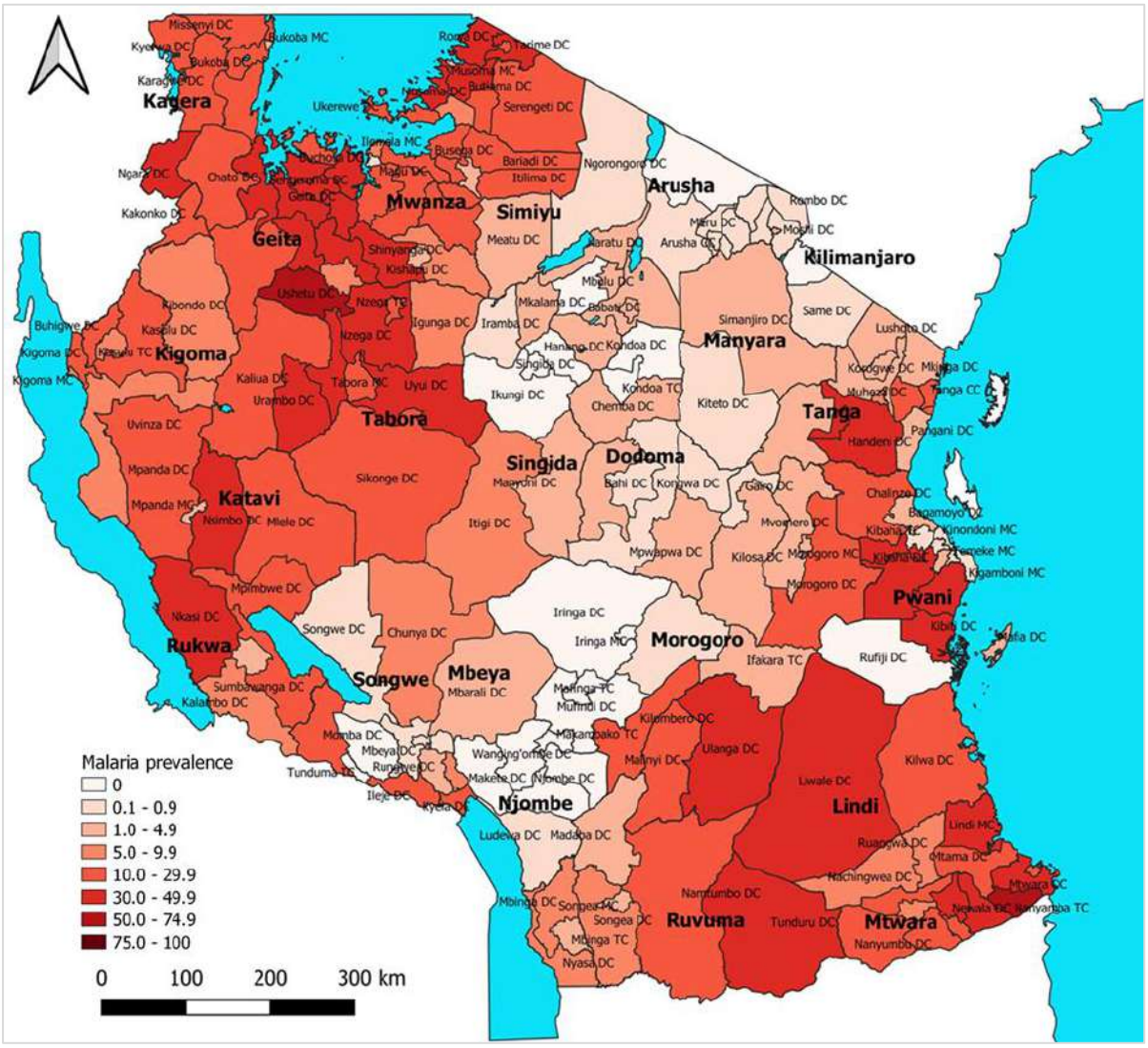


Figure 8. Council malaria prevalence among SAC aged 5–16 years



Disaggregated findings from councils showed the highest prevalence of malaria in Ushetu (66.2%) followed by Nanyamba (53.9%), Nyang'hwale (48.1%), Rorya (48.1%) and Mkuranga (47.9%) (Figure 8**)**. Out of 184 councils, 38 (20.7%) recorded no malaria infections (0.0%) while 60 (32.6%) councils recorded malaria prevalence ≤1%. Moreover, 14 of 184 councils had malaria prevalence above ≥40%; they were dispersed over the Eastern, Lake, Southern, Southwest Highlands and Western zones (**Table 6 and Figure 8)**.

Figure 9. School malaria prevalence amongst SAC aged 5–16 years

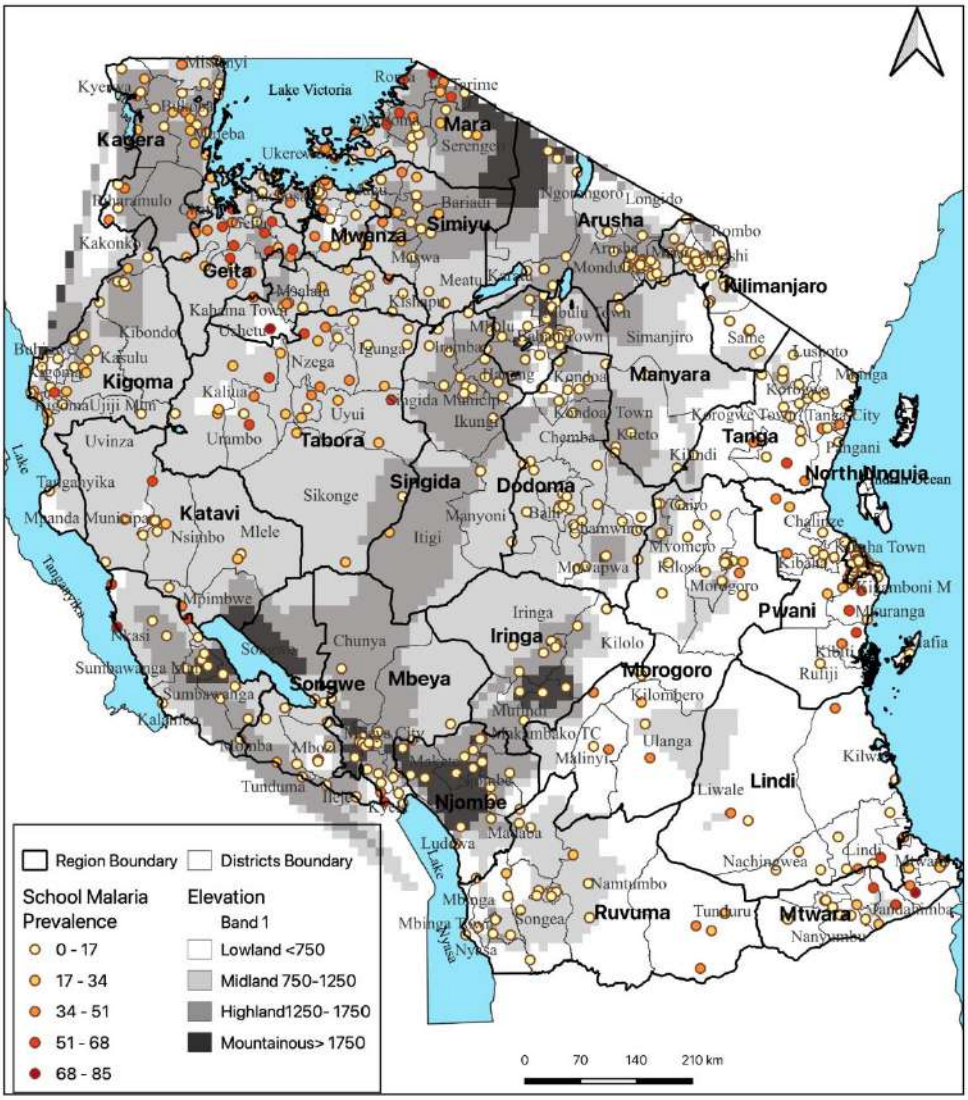


Table 6: Prevalence of malaria infection amongst SAC aged 5–16 years

BACKGROUND CHARACTERISTICS	TESTED POSITIVE (%)	NUMBER OF CHILDREN TESTED
Overall prevalence	11.8	64,465
Sex		
Girls	10.7	32301
Boys	12.9	32164
Body temperature		
Fever	30.9	4,993
Normal	10.2	59,472
Age (years)		
5–8	9.5	20,196
9–12	11.8	34,018
13–16	16.5	10,166
Anaemia		
Anaemia (Hb <11g/dl)	18.9	7,118

BACKGROUND CHARACTERISTICS	TESTED POSITIVE (%)	NUMBER OF CHILDREN TESTED
Non-anaemia	8.4	15,178
History of fever		
Yes	20.3	3,396
No	10	16,990
Do have a mosquito net at home?		
Yes	12.7	16,863
No	8.4	4870
Did you sleep under mosquito net last night?		
Yes	12.1	14,585
No	16.4	2,278
Distance of the school to the nearby health facility		
Less than 5km	9.6	31,949
5km or more	14.0	32,516
Elevation		
Below 750m	12.4	20,767
750–<1250m	15.3	23,233
1250–1750m	8.3	17,214
Above 1750	1.1	3,251
Malaria epidemiological strata		
Very low	0.1	10,633
Low	1.4	15,618
Moderate	10.2	14,684
High	25.1	23,530
Geographical zone		
Central	0.6	7,697
Northern	4.1	8,833
Southern Highlands	4.3	5,614
Eastern	7.7	10,519
Southwest Highlands	9.8	6,443
Western	19.5	6,061
Lake	22.5	15,637
Southern	22.5	3,661
Region		
Geita	38.5	2,309
Tabora	26.9	3,205
Mara	26.4	2,696
Mtwara	24.2	2,240
Shinyanga	23.8	1,864
Katavi	22.0	1,200
Pwani	21.7	2,008
Lindi	19.6	1,421
Kagera	17.7	3,325
Mwanza	17.2	3,553
Simiyu	14.7	1,892

BACKGROUND CHARACTERISTICS	TESTED POSITIVE (%)	NUMBER OF CHILDREN TESTED
Rukwa	13.4	1,704
Tanga	12.4	2,885
Kigoma	11.2	2,856
Morogoro	10.7	3,198
Ruvuma	10.4	2,278
Songwe	4.2	1,415
Mbeya	3.8	2,124
Singida	1.5	1,986
Dar es Salaam	0.7	5,313
Dodoma	0.4	2,831
Njombe	0.2	1,724
Arusha	0.1	3,016
Iringa	0.1	1,610
Kilimanjaro	0.1	2,932
Manyara	0.1	2,880

Mosquito net ownership, access and use

3.3 Ownership of mosquito nets amongst SAC

The findings show that 77.6% of the SAC interviewed reported having a mosquito net at home. Of those who had mosquito nets at home, 89.6% reported usually using the mosquito net, and 86.5% slept under the mosquito net the night before the survey (**Table 7**). Results also revealed that most of the SAC reported having at most two people (including the respondent) who slept under a single mosquito net the night before the survey (**Table 7**).

Age and gender

Out of the SAC interviewed, 77.9% of girls and 77.3% of boys reported having a mosquito net at home. Comparable proportions of girls (90.1%) and boys (89.0%) reported usually sleeping under a mosquito net. Similarly, 87.3% and 85.7% of girls and boys, respectively, reported having slept under a mosquito net the night before the survey.

A slightly higher proportion of mosquito net ownership (84.9%) was reported among SAC aged 13–16 years. A high proportion of SAC across all age groups reported usually sleeping under a mosquito net. Similarly, comparably higher proportions of SAC across all age groups reported having slept under a mosquito net the night before the survey (**Table 7**).

Elevation

The results reveal that, mosquito net ownership and use among SAC decreased with increasing altitude, where ownership ranged from 52% in areas with altitude of above 1750m asl to 82.7% those with altitude below 750m asl.

Malaria epidemiological strata

Mosquito net ownership was highest amongst SAC residing in high malaria epidemiological strata (88.2%) and the lowest amongst SAC residing in very low epidemiological strata (48.2%) (**Table 7**). On the other hand, 88.7%, 92.7% and 91.1%, of SAC residing in low, moderate and high malaria epidemiological strata, respectively, reported usually using

mosquito nets; while mosquito net use in very low malaria epidemiological strata was slightly lower at 78%. Similarly, SAC residing in the very low malaria epidemiological strata reported relatively lower mosquito net use the night before the survey compared to SAC in other epidemiological strata (**Table 7**).

Geographical zones

Mosquito net ownership among SAC ranged from 59.9% to 89.7% in the Northern and Western zones, respectively. In general, 80% of SAC across all geographical zones reported usually using mosquito nets, with highest being 94.5% in the Eastern zone. Similarly, reported mosquito net use the night before the surveyed ranged from 79.3% in the Northern zone to 92.8% in the Eastern zone (**Table 7**).

Regions

Most SAC (95.9%) who reported having a mosquito net in their household were recorded from Mara region followed by Tabora (92.1%) and Lindi (91.9%); the lowest percentage of SAC (41%) with mosquito nets was recorded in Njombe region. The highest percentages of SAC who usually use mosquito net were reported in Pwani (95.9%), Morogoro (95.2%) and Mtwara (94.8%) and the lowest (72.6%) was reported in Njombe. Sleeping under a mosquito net the night before the survey was highest (94.1%) in Morogoro and Pwani regions followed by Mara (93.0%), and the lowest incidence of sleeping under a mosquito net the night before the survey was reported in Njombe region (66.4%) **(Table 7).**

Table 7: Mosquito net ownership and use amongst SAC aged 5–16 years

BACKGROUND CHARACTERISTICS	MOSQUITO NET OWNERSHIP		MOSQUITO NET USE			NUMBER OF PERSONS (INCLUDING INTERVIEWEE) WHO SHARED 1 MOSQUITO NET LAST NIGHT				
	REPORTED MOSQUITO NET OWNERSHIP AT HOME (%)	TOTAL INTERVIEWED	USUALLY, USE MOSQUITO NET (%)	SLEPT UNDER MOSQUITO NET THE NIGHT BEFORE THE SURVEY (%)	REPORTED HAD MOSQUITO NET AT HOME (NUMBER)	1	2	3	4	NUMBER RESPONDED
Total	**77.6**	**21,733**	**89.6**	**86.5**	**16863**	**12.3**	**47.4**	**24.5**	**15.8**	**14,585**
Gender										
Girls	77.9	10,869	90.1	87.3	8,463	10.7	47.5	25.5	16.3	7,390
Boys	77.3	10,864	89	85.7	8,400	13.9	47.4	23.6	15.2	7,195
Age (years)										
5 – 8	70.0	6,749	89.0	86.8	4,724	10.4	48.1	25.7	15.8	4,101
9 – 12	79.8	11,530	89.8	86.5	9,206	12.8	46.7	24.4	16.1	7,966
13 – 16	84.9	3,454	89.8	85.9	2,933	13.7	48.7	23	14.6	2,518
Elevation										
Below 750m	82.7	7,081	93	90.2	5,854	15.7	42.6	22.7	19	5,283
750–1250m	82.4	7,809	90.6	87.4	6,437	10.3	49.2	27	13.5	5,624
1250–1750m	69.6	5,757	85.3	82.2	4,007	9.8	51.9	23.8	14.5	3,294
Above 1750	52.0	1,086	71.9	68	565	14.3	49.5	20.6	15.6	384
Epidemiological malaria strata										
Very low	48.2	3731	78	74.4	1,800	10	48.9	24.7	16.4	1,339
Low	76.9	5,267	88.7	85.7	4,048	11.4	47	23.7	17.9	3,470
Moderate	83.7	4,902	92.7	90.2	4,105	10.9	50.6	23.8	14.6	3,701
High	88.2	7,833	91.2	87.9	6,910	14	45.4	25.4	15.1	6,075
Geographical zone										
Central	70.9	2,592	85.9	82.3	1,837	7.1	53.9	23.1	15.8	1,512
Eastern	84.2	3,538	94.5	92.8	2,978	12.6	40.3	25.2	21.8	2,765
Lake	88.1	5,107	90.9	88.3	4,497	10.4	51	26.6	12.0	3,973
Northern	59.9	3,020	83.9	79.3	1,810	11.2	50.1	25	13.7	1,436
Sothern Highlands	64.6	1,936	85.7	82.3	1,250	12.8	47	19.6	20.5	1,029
Southwest Highlands	68.5	2,229	86.4	82.6	1,527	13.8	50.8	22.3	13.1	1,262
Southern	89.2	1,264	94.3	91.7	1,128	26.8	37.5	17	18.7	1,034
Western	89.7	2047	89.8	85.7	1,836	11	46.4	29	13.5	1,574

BACKGROUND CHARACTERISTICS	MOSQUITO NET OWNERSHIP		MOSQUITO NET USE			NUMBER OF PERSONS (INCLUDING INTERVIEWEE) WHO SHARED 1 MOSQUITO NET LAST NIGHT				
	REPORTED MOSQUITO NET OWNERSHIP AT HOME (%)	TOTAL INTERVIEWED	USUALLY, USE MOSQUITO NET (%)	SLEPT UNDER MOSQUITO NET THE NIGHT BEFORE THE SURVEY (%)	REPORTED HAD MOSQUITO NET AT HOME (NUMBER)	1	2	3	4	NUMBER RESPONDED
Region										
Arusha	53.8	1,035	81.1	77.6	557	6.3	43.8	25.2	24.8	432
Dar es Salaam	82.7	1,850	93.5	91.6	1,530	11.1	35.4	26.2	27.2	1,402
Dodoma	85.5	974	89.3	86.9	833	7.7	45.4	24.7	22.1	724
Geita	84.1	753	83.9	79.0	633	4.4	36.8	29.0	29.8	500
Iringa	60.0	522	78.0	74.4	313	10.7	59.2	15.9	14.2	233
Kagera	88.5	1,097	92.3	89.7	971	9.9	55.8	22.6	11.7	871
Katavi	78.5	433	93.2	91.2	340	8.4	51.3	28.1	12.3	310
Kigoma	87.0	978	91.1	88.5	851	12.9	55.1	27.8	4.2	753
Kilimanjaro	47.6	1,010	76.5	72.6	481	15.5	54.4	21.5	8.6	349
Lindi	91.9	491	93.6	92.2	451	31.0	37.7	13.5	17.8	416
Manyara	54.0	955	84.3	81.2	516	6.2	58.9	20.5	14.3	419
Mara	95.9	822	94.7	93.0	788	12.3	49.2	27.7	10.8	733
Mbeya	71.3	708	84.0	81.2	505	20.2	51.7	15.1	12.9	410
Morogoro	82.3	993	95.2	94.1	817	11.8	45.1	23.5	19.5	769
Mtwara	87.6	773	94.8	91.3	677	23.9	37.4	19.4	19.3	618
Mwanza	88.0	1,145	93.5	92.8	1,008	13.2	50.5	29.1	7.3	935
Njombe	41.0	632	72.6	66.4	259	19.2	30.8	20.9	29.1	172
Pwani	90.8	695	95.9	94.1	631	17.2	45.6	25.1	12.1	594
Rukwa	65.7	577	85.8	80.2	379	5.9	43.4	32.2	18.4	304
Ruvuma	86.7	782	94.2	92.0	678	11.9	47	20.7	20.5	624
Shinyanga	88.8	642	92.3	88.1	570	11.4	58.4	22.5	7.8	502
Simiyu	81.3	648	85.0	82.0	527	8.1	53.5	29.4	9.0	432
Singida	73.6	663	81.8	756	488	7.0	64.8	23.0	5.1	369
Songwe	59.3	511	83.5	78.5	303	19.7	58.0	14.7	7.6	238
Tabora	92.1	1,069	88.6	83.4	985	9.3	38.5	30.2	22.0	821
Tanga	79.2	975	90.4	84.8	772	12.2	51.9	26.7	9.2	655

Mosquito net ownership, access and use at the household level

A total of 6,822 households were surveyed; of them, 83.5% reported owning at least one of any type of mosquito net. The ownership of at least one LLIN in a household was slightly lower (78.1%). The results further indicate that the overall proportion of households with at least one of any type of mosquito net for every two people was 50.3%, while the proportion of households with at least one LLIN for every two people was 44.3%.In addition, access to any mosquito net was 70.7% whereas access to an LLIN was slightly lower (64.9%) (**Table 8).**

Malaria epidemiological strata

Ownership of at least one of any mosquito nets increased with increasing malaria burden; ownership was high (94.2%) in malaria high epidemiological stratum and lowest (48.2%) in very low malaria stratum. A similar trend was observed in the ownership of at least one LLIN per household (**Table 8**).

The proportion of households with at least one of any type of mosquito net for every two people who stayed in the household the night before the survey was high in moderate (56.3%) and high (57.4%) malaria epidemiological strata and lowest (25.5%) in very low malaria epidemiological stratum. On the other hand, the proportion of households with at least one LLIN for every two people who stayed in the household the night before the survey was 52.8% in high malaria epidemiological stratum and lowest (23.2%) in the very low malaria epidemiological stratum (**Table 8**).

Population access to any mosquito net was comparably higher (>70%) in high, moderate and low malaria epidemiological strata whilst the lowest access (37.1%) was seen in the very low strata. Access to LLINs was highest (74.9%) in the very high epidemiological strata and lowest in very low strata (35.5%) (**Table 8**).

Geographical zones

The highest proportion of households that reported owning at least one of any mosquito net was high (96.0%) in Southern zone and low (65.2%) in Northern zone. Ownership of at least one LLIN ranged from 60.2% to 92.3% in the Southern and Southern Highlands zones, respectively.

The proportion of households with at least one of any type of mosquito net for every two people who stayed in the household the night before the survey was highest in the Southern zone (74.2%) and lowest in the Northern zone (38.9%). The proportion of households with at least one LLIN for every two people who stayed in the household the night before the survey was slightly lower, ranging from 36.4% to 66.5% in the Southern Highlands and Southern zones, respectively (**Table 8**).

Highest population access to LLIN was recorded in the Southern zone (83.4%) and western zone (72.9%) compared to the Southern Highlands (53.7%) and Northern zones (54.6%) (**Table 8**).

Regions

Thirteen out of 26 (50%) regions of Mainland Tanzania attained the national goal (85.0%) of the number of households owning at least one LLIN (**Table 10**). LLIN ownership was highest in Lindi (96.6%) and lowest in Njombe (35.3%) (**Figure 10**).

Figure 11 shows the highest proportion of households with at least one LLIN for every two people per household the night before the survey was recorded in Lindi (68.5%), and the lowest was in Iringa (16.7%) (**Table 8)**

Household population access to LLINs was highest in Lindi (87.3%) and lowest in Arusha (29.4%) (**Figure 12**).

Figure 10. Households with at least one LLIN, by region

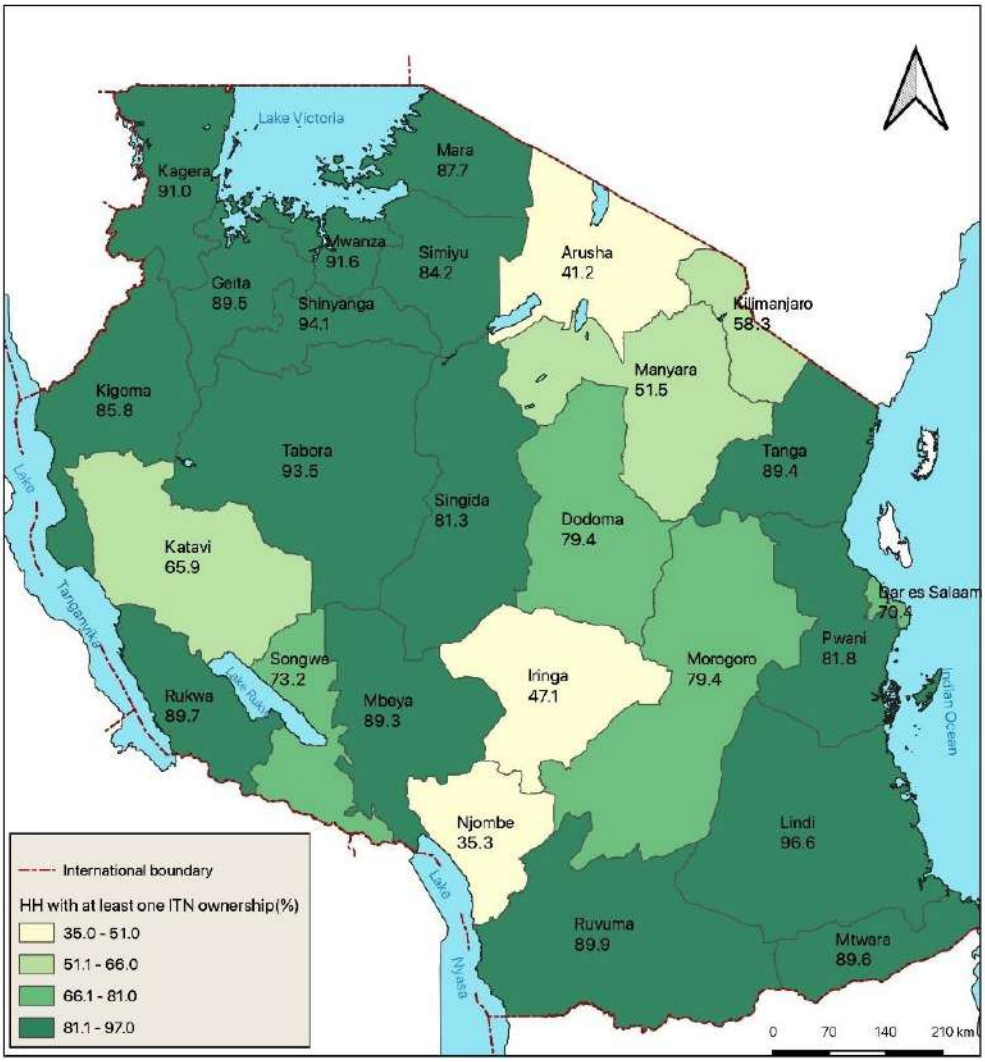


Figure 11. Households with at least one LLIN for every two people, by region

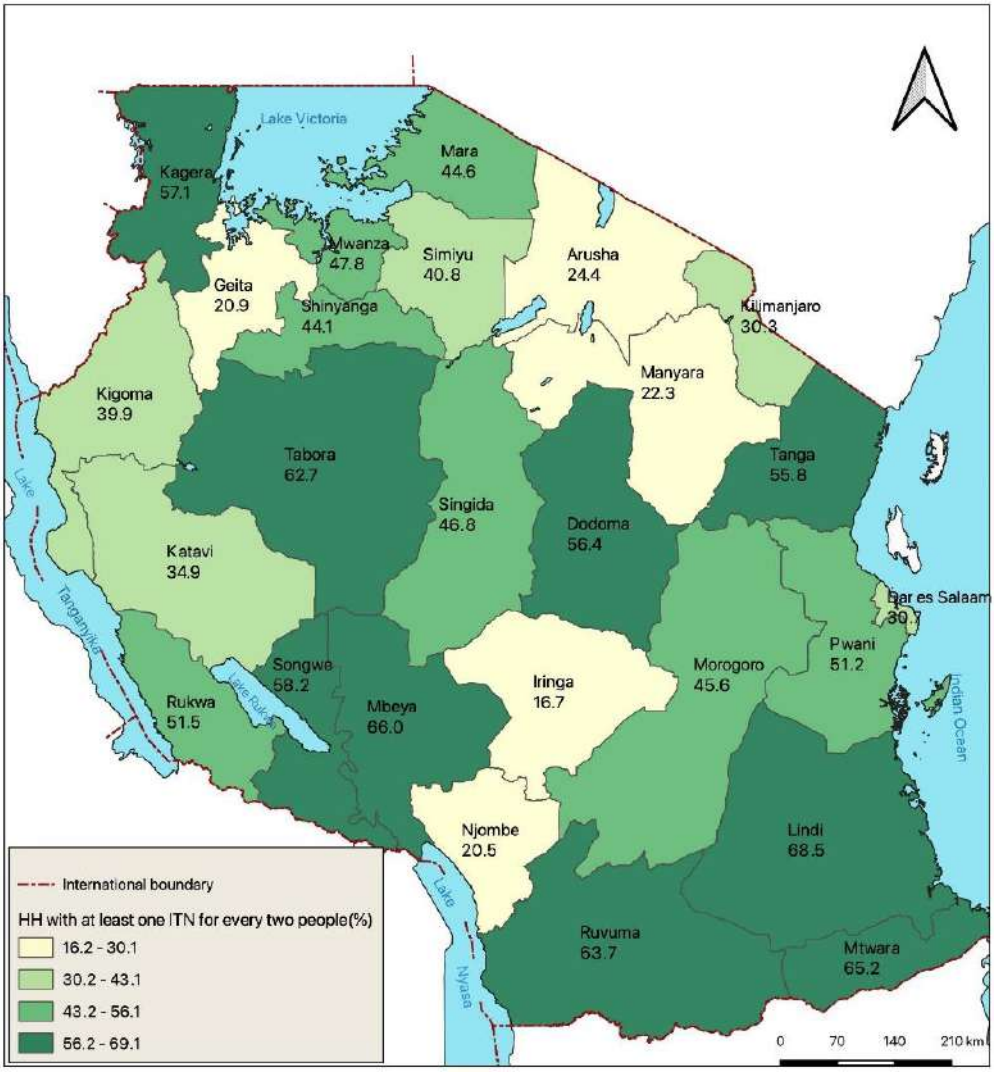


Figure 12. Household population with access to an LLIN, by region

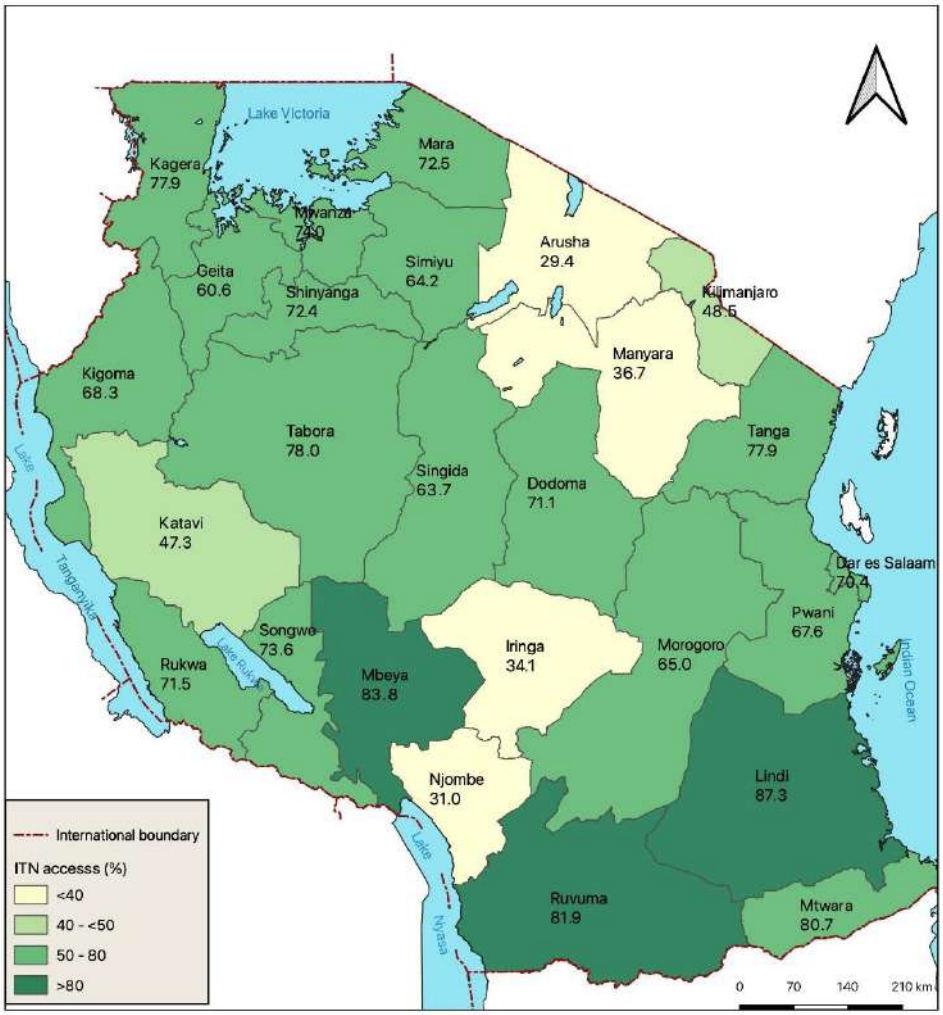


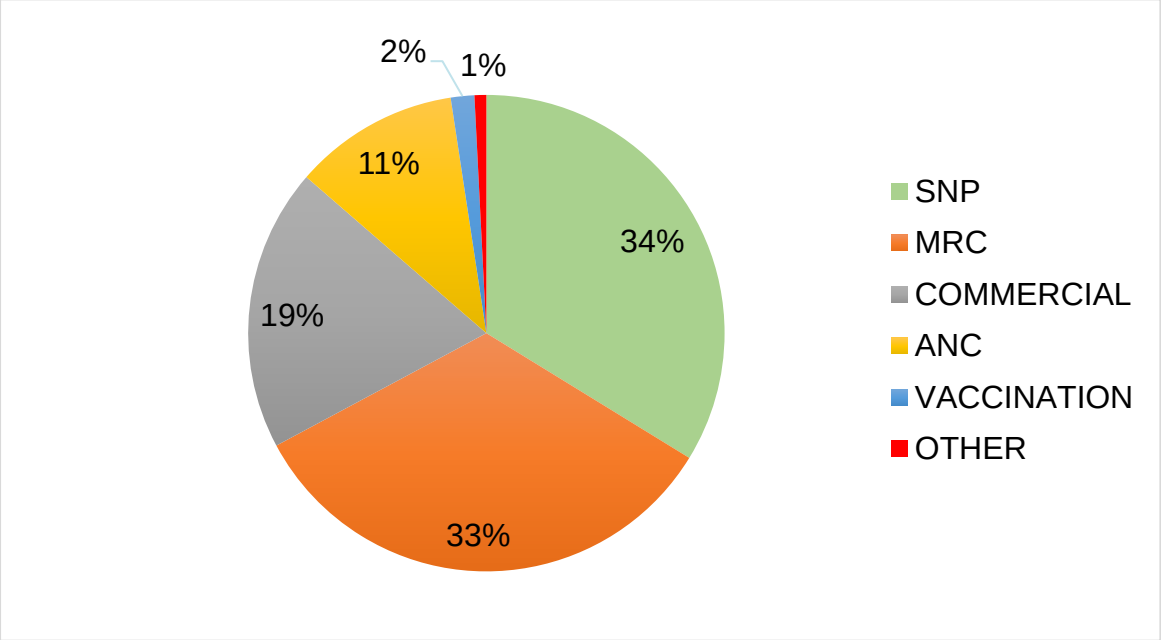
Table 8: Mosquito net ownership and access among surveyed households

BACKGROUND CHARACTERISTICS	POSSESSION OF ANY NET (%)	NUMBER	TOTAL	POSSESSION OF LLIN (%)	NUMBER	TOTAL	HOUSEHOLD WITH ANY NET FOR EVERY 2 PEOPLE (%)	NUMBER	TOTAL	PROPORTION OF HOUSEHOLDS WITH 1 LLIN FOR EVERY 2 PEOPLE	NUMBER	TOTAL	PERCENTAGE ACCESS TO ANY NET	PERCENTAGE ACCESS TO LLIN
Total	**83.5**	**5699**	**6822**	**78.1**	**5325**	**6822**	**50.3**	**3423**	**6809**	**44.3**	**3019**	**6809**	**70.7**	**64.9**
Geograpical zone														
Central	72.8	573	787	69.4	546	787	44.1	347	786	41.1	323	786	59.8	56.4
Eastern	87.8	974	1109	75.4	836	1109	49.7	551	1109	39.2	435	1109	71.4	59.1
Lake	94.7	1527	1613	89.9	1450	1613	51.5	829	1610	44	708	1610	76.3	70.7
Northern	65.2	607	931	62.4	581	931	38.9	362	931	36.5	340	931	57.2	54.6
Southern Highlands	67.9	408	601	60.2	362	601	41.8	251	601	36.4	219	601	58.8	53.7
Southwest Highlands	86	672	781	82.2	642	781	57.8	450	778	54.2	422	778	75.4	71.0
Southern	96	361	376	92.3	347	376	74.2	279	376	66.5	250	376	88.5	83.4
Western	92.5	577	624	89.9	561	624	57.3	354	618	52.1	322	618	77.3	72.9
Total	**83.5**	**5699**	**6822**	**78.1**	**5325**	**6822**	**50.3**	**3423**	**6809**	**44.3**	**3019**	**6809**	**70.7**	**64.9**
Malaria epidemiological strata														
Very low	48.2	547	1135	45.9	521	1135	25.5	289	1132	23.2	263	1132	37.1	35.5
Low	84.4	1371	1625	73.9	1201	1625	50.8	825	1624	42.1	683	1624	71.0	60.9
Moderate	91.5	1492	1631	85.4	1393	1631	56.3	919	1631	48.7	794	1631	77.1	69.8
High	94.2	2289	2431	90.9	2210	2431	57.4	1390	2422	52.8	1279	2422	78.6	74.9
Total	**83.5**	**5699**	**6822**	**78.1**	**5325**	**6822**	**50.3**	**3423**	**6809**	**44.3**	**3019**	**6809**	**70.7**	**64.9**

Sources of mosquito nets in households

Based on the findings in **Figure 13, the** School Net Programme (SNP) was the leading source of mosquito nets, as reported in the surveyed households by 34.3% followed by mass replacement campaigns (33%). The least reported source of mosquito nets was immunization and vaccine development.

Figure 13. Source of mosquito net at household level



3.4 School absenteeism

Of the 21,689 interviewed SACs, 15.8% were absent from school two weeks prior to the survey. Fever was the most reported reason for absenteeism at 60.9%, followed by 26.8% other symptoms and 12.3% for other reasons **(Table 9)**.

Age and gender

Among interviewed SAC, 16.3% of girls and 15.3% of boys were absent two weeks prior to the survey. The majority of the SAC cited fever as the main cause of absenteeism (boys, 60.3%, and girls, 61.5%). With regards to age, 16.5% of SAC 9–12 years old were absent followed by 16.0% and 14.5% of those aged 13–16 and 5–8 years old, respectively. Results show that a higher proportion (66.8%) of older SAC aged 13–16 years reported fever as a reason for school absenteeism compared to other age groups **(Table 9)**.

Elevation

Results show school absenteeism increased with decreasing altitude; 20.3% of absent SAC hailed from low land (below 750m), followed by 17.0%, 10.2% and 8.1%, from midland (750–1250m), highlands (1250–1750m) and mountainous areas (above 1750m), respectively. In addition, fever was the leading cause of school absenteeism in the lowland (63.8%) followed by midland (62.5%) and the least mentioned in the mountainous areas (46.6%).

Malaria epidemiological strata

Absenteeism among SAC was more prevalent in areas with high malaria burden; it was high (20.5%) in high malaria epidemiological zones and lowest (7.2%) in very low strata. The highest proportion of SAC (68.2%) from high malaria epidemiological strata reported fever as the reason for being absent from school.

Geographical zones and regions

The highest proportion of SAC in the Eastern (21.3%) and Southern zones (20.4%) reported being absent from school two weeks prior to the survey, whilst slightly lower proportions were recorded in the Northern (11.0%) and the Southwest Highlands zones (9.1%). In addition, fever as the reason for school absenteeism was more prominent in the Western zone (70.1%) and Southern Highlands (66.8%). Region wise, school absenteeism ranged from 2.2% in Manyara to 33.0% in Pwani **(Figure 14).**

Figure 14. School absenteeism and reported reasons by region

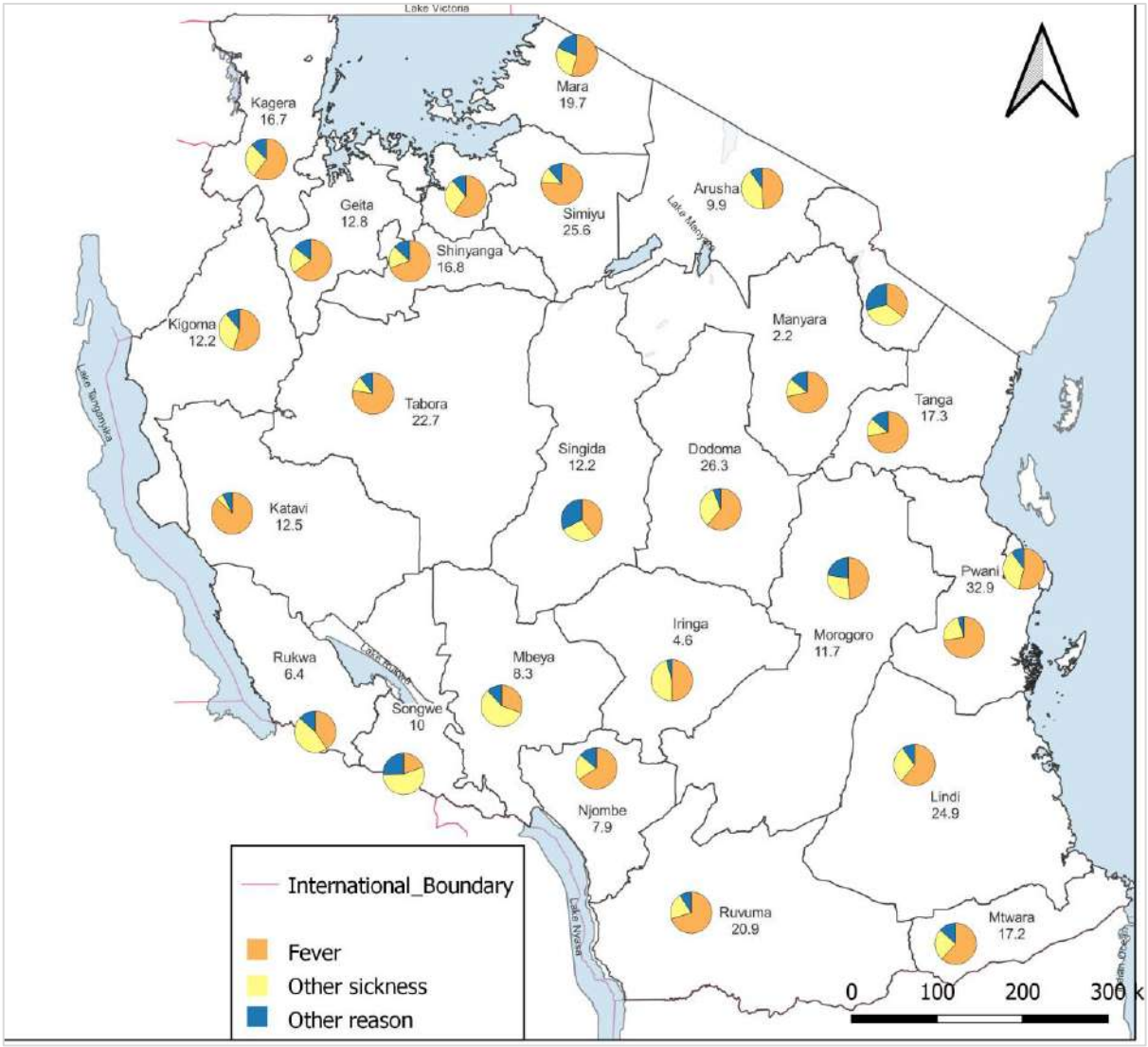


Table 9: School absenteeism and reported reasons among SAC

BACKGROUND CHARACTERISTICS	SCHOOL ABSENTEEISM IN PAST 2 WEEKS BEFORE SURVEY (%)	NUMBER OF SAC INTERVIEWED	REASONS FOR SCHOOL ABSENTEEISM SAC			
			FEVER	OTHER SICKNESS	OTHER REASONS	NUMBER OF SAC RESPONDED
Total	**15.8**	**21689**	**60.9**	**26.8**	**12.3**	**3427**
Gender						
Girls	16.3	10837	61.5	26.5	12	1770
Boys	15.3	10852	60.3	27.2	12.5	1657
Age (years)						
5–8	14.5	6697	57.2	29.1	13.7	973
9–12	16.5	11497	61.1	26.9	12	1893
13–16	16	3441	66.8	23	10.1	552
Elevation						
Below 750m	20.3	7016	63.8	26	10.2	1426
750–1250m	17	7782	62.5	25.1	12.4	1323
1250–1750m	10.2	5743	52.4	31.2	16.4	586
Above 1750	8.1	1088	46.6	37.5	15.9	88
Malaria epidemiological strata						
Very low	7.2	3729	42.3	36	21.7	267
Low	15.5	5202	54.3	35.2	10.4	806
Moderate	15.3	4875	59.1	27.1	13.8	745
High	20.5	7823	68.2	21	10.8	1605
Geographical zone						
Southwest Highlands	9.1	2216	44.8	40.8	14.4	201
Northern	11	3033	58	26.4	15.6	333
Southern Highlands	12.3	1935	66.8	23.5	9.7	238
Central	13.5	2591	57	31.1	12	351
Western	17.7	2061	70.1	19.2	10.7	364
Lake	18.4	5110	63.1	23.3	13.6	941
Southern	20.4	1258	61.5	26.8	11.7	257
Eastern	21.3	3485	59	30.6	10.4	742

3.5 Treatment-seeking behaviour

Of the SAC surveyed, 16.6% reported experiencing fever two weeks before the survey. Of these, 82.0% sought treatment advice or treatment. A majority (71.4%) of SAC who experienced fever sought treatment advice or treatment at a health facility, followed by drug outlets (25.8%). Only 2.8% of SAC sought advice from traditional healers and other sources**.**

Age and gender

Of the SAC interviewed, 17.3% and 15.9% of girls and boys, respectively, reported experiencing fever or high body temperature two weeks before the survey. A large proportion of both boys (70.3%) and girls (72.4%) sought treatment from health facilities. Agewise, the proportions of SAC aged 9–12 years who reported experiencing fever two weeks before the survey was slightly higher (17.3%), compared to 15.2% and 16.9% of pupils aged 5–8 and 13–16 years, respectively.

Elevation and malaria epidemiological strata

Findings indicate that the proportion of SAC with fever two weeks prior to the survey increased with decreasing altitude. The highest proportion of SAC (22.4%) with fever two weeks prior to the survey resided in the low land areas (below 750m), whilst 17.7% of SACs with fever two weeks before the survey was from the midlands (750–1250m), 9.7% from the highlands (1250 – 1750m) and the least proportion, 8.8%, from mountainous areas (above 1750m).

A similar trend was noted with malaria epidemiological strata whereby a higher proportion of SAC residing in high malaria transmission areas had a fever two weeks before the survey 23.8% followed by 16.1%, 13.2% and the lowest, 7.0%, in moderate, low and very low transmission areas, respectively. Generally, more than half of the SAC with fever sought treatment from the health facilities.

Geographic zones and regions

Nearly one-third of the SAC residing in the Southern zone reported having a fever two weeks prior to the survey, followed by the Eastern (20.9%), Western (19.4%) and, the lowest proportion of SAC with fever, the Southwest Highlands zones (9.2%). Across geographical zones, the rate of seeking treatment in health facilities was reported to be above 60%.

Region wise, Pwani recorded the highest number of SAC (34.7%) who had a fever two weeks prior to the survey, of whom 70.3% sought treatment at a health facility. Manyara and Iringa regions recorded the least number of SAC (2.8% and 2.9%) who had a fever two weeks before the survey (**Table 10**).

Table 10: Malaria treatment seeking behaviour among SAC

BACKGROUND CHARACTERISTICS	PROPORTION WHO HAD FEVER TWO WEEKS BEFORE SURVEY	NUMBER OF PUPILS INTERVIEWED	PROPORTION WHO HAD FEVER TWO WEEKS BEFORE SURVEY AND SOUGHT TREATMENT ADVICE	NUMBER OF PUPILS WITH FEVER TWO WEEKS BEFORE SURVEY	AREAS WHERE TREATMENT/ADVICE WAS SOUGHT BY SAC				
					HEALTH FACILITIES	DRUG OUTLET	TRADITIONAL MEDICINE	OTHERS	NUMBER OF PUPILS WITH FEVER, HIGH BODY TEMPERATURE AND ATTENDED HEALTH CARE FACILITY TO SEEK TREATMENT ADVICE
Total	**16.6**	**20349**	**82**	**3377**	**71.4**	**25.8**	**1.4**	**1.4**	**2769**
Gender									
Girls	17.3	10155	82.1	1757	72.4	24.9	1.3	1.4	1442
Boys	15.9	10194	81.9	1620	70.3	26.8	1.4	1.4	1442
Age (years)									
5–8	15.2	6281	84.2	955	72.1	24.9	1.1	1.9	804
9–12	17.3	10760	82.8	1863	72	25.6	1.2	1.2	1543
13–16	16.9	3258	75.1	550	68.3	27.8	2.7	1.2	413
Do have a mosquito net at home?									
Yes	18.7	15703	83.1	2929	71.6	25.6	1.4	1.4	2433
No	9.6	4646	75	448	70.2	27.4	1.2	1.2	336
Did you sleep under a mosquito net last night?									
Yes	18.7	13569	84.9	2537	73.4	24	1.4	1.2	2154
No	18.4	2134	71.2	392	57.7	37.6	1.4	3.2	279
Distance of the school from the nearby health facility									
Within 5km	15.0	10051	82.9	1512	74.1	23.2	1.4	1.3	1253

5km or more	18.1	10240	81.3	1856	69.1	28.1	1.3	1.5	1508
Elevation									
Below 750m	22.4	6500	85.7	1456	72.7	24.6	1.4	1.3	1248
750–1250m	17.7	7286	81.6	1291	69.9	27	1.1	1.9	1054
1250–1750m	9.7	5464	72.2	529	69.1	28.3	1.8	0.8	382
Above 1750	8.8	1041	83.7	92	80.5	19.5	0	0	77
Malaria epidemiological strata									
Very low	7	3575	75.9	249	78.8	19.6	1.1	0.5	189
Low	13.2	4834	88	640	78.7	19.2	1.1	1.1	563
Moderate	16.1	4570	84.3	738	72.7	23.8	1.3	2.3	622
High	23.8	7312	79.7	1741	66.8	30.4	1.5	1.3	1387
Geographical zone									
Central	10.5	2440	81.3	257	76.6	21.1	1.9	0.5	209
Eastern	20.9	3181	89.8	666	76.9	20.1	1.3	1.7	598
Lake	19	4763	78.1	907	72.6	24.3	2	1.1	708
Northern	12.7	2893	80.6	366	62.4	34.9	1.4	1.4	295
Southern Highlands	15.7	1856	84.2	292	76.4	19.9	0	3.7	246
Southwest Highlands	9.2	2105	78.9	194	61.4	35.9	0.7	2	153
Southern	27.3	1159	75.6	316	74.5	23.4	1.7	0.4	239
Western	19.4	1952	84.7	379	62	36.1	0.9	0.9	321
Region									
Arusha	9.9	980	72.2	97	78.6	21.4	0.0	0.0	70
Dar es Salaam	21.7	1620	90.6	351	83	15.4	0.6	0.9	318
Dodoma	20.6	871	91.1	179	77.9	20.2	1.8	0.0	163
Geita	13.6	719	64.3	98	68.3	30.2	0.0	1.6	63
Iringa	2.9	511	93.3	15	78.6	14.3	0.0	7.1	14
Kagera	14.4	1023	74.1	147	68.8	28.4	1.8	0.9	109
Katavi	18.2	422	83.1	77	51.6	45.3	1.6	1.6	64
Kigoma	12.6	925	81.2	117	52.6	47.4	0.0	0.0	95
Kilimanjaro	5.6	971	74.1	54	60	35.0	2.5	2.5	40

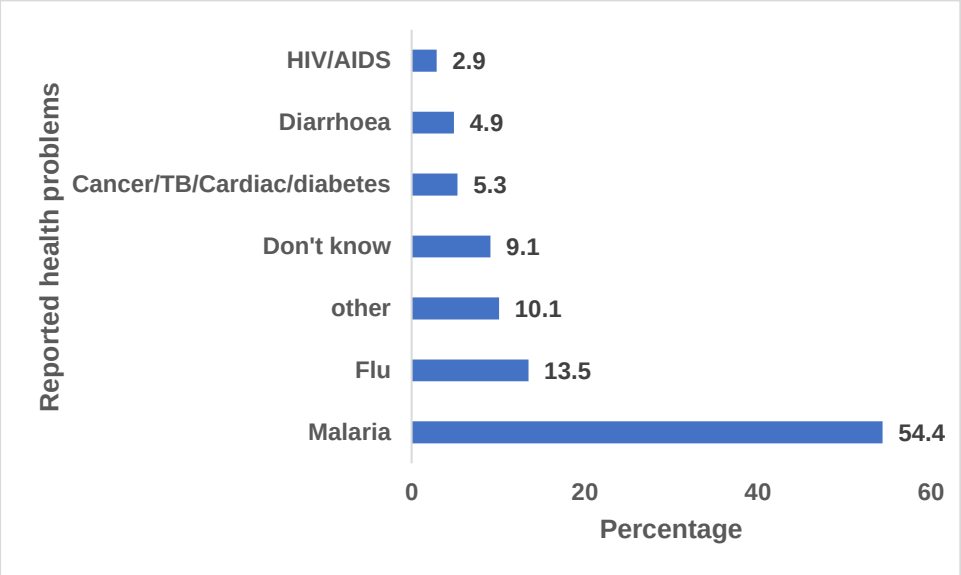
Lindi	28.3	438	75.8	124	68.1	30.9	1.1	0.0	94
Manyara	2.8	949	63	27	70.6	23.5	5.9	0.0	17
Mara	26.4	777	74.6	205	63.4	32.7	2.6	1.3	153
Mbeya	7.4	663	81.6	49	92.5	5.0	0.0	2.5	40
Morogoro	10.2	925	93.6	94	69.3	26.1	0.0	4.5	88
Mtwara	26.6	721	75.5	192	78.6	18.6	2.1	0.7	145
Mwanza	17.7	1034	82.5	183	68.2	28.5	2.0	1.3	151
Njombe	11.1	613	85.3	68	93.1	6.9	0.0	0.0	58
Pwani	34.7	636	86.9	221	70.3	25.0	3.1	1.6	192
Rukwa	7.8	551	74.4	43	37.5	59.4	0.0	3.1	32
Ruvuma	28.6	732	83.3	209	70.7	24.7	0.0	4.6	174
Shinyanga	18.3	607	81.1	111	73.3	22.2	3.3	1.1	90
Simiyu	27	603	87.1	163	91.5	6.3	1.4	0.7	142
Singida	8.2	620	56.9	51	72.4	24.1	0.0	3.4	29
Songwe	5.3	469	68	25	70.6	29.4	0.0	0.0	17
Tabora	25.5	1027	86.3	262	65.9	31.4	1.3	1.3	226
Tanga	22.8	942	86	215	56.8	40.0	1.6	1.6	185

3.6 Malaria knowledge

Household perception of health problems

A total of 6,782 households were interviewed on the major health problem facing their community. Malaria was considered the major problem reported (54.4%), followed by flu (13%), diarrhoea (4.2) and HIV/AIDS 2.9% (Figure 15 and **Table 11**). The responses also differed with the different background characteristics of the respondents.

Figure 15: Reported major health problems iat households' level



More than half of household respondents (55%) with primary or no education considered malaria the major health problem, whilst ony 47% of respondents with secondary or higher education considered malaria the major problem.

Malaria epidemiological strata

Across all malaria epidemiological strata, there was a marked trend of increasing reports of malaria as a major health problem with increasing malaria burden, where the highest reports of malaria as a health problem (81.6%) were recorded in high malaria epidemiological strata and the lowest (15.9%) in very low epidemiological strata.

Geographical zone

Malaria was reported as the major health problem in Western zone (82%) followed by Lake zone (78.9%) and least reported in Northern zone (29.9%).

Regions

Most household respondents (90.4%) from Tabora reported malaria as a major health problem followed by respondents hailing from Simiyu (84.8%) and Mara (83.6%) regions, while the lowest proportions were 7.1% and 9.5% in Arusha followed by Kilimanjaro, respectively (**Table 11**).

Table 11: Most serious health problem in the community

BACKGROUND CHARACTERISTICS	MALARIA	FLU	DIARRHOEA	CANCER, TUBERCULOSISCARDIAC DISEASE, DIABETES	HIV/AIDS	OTHERS	DON'T KNOW	NUMBER OF HOUSEHOLDS
Highest level of education of the household head								
No education	55.2	10.2	4.2	3.6	2.3	8.3	16.1	527
Incomplete primary education	55.2	12.6	7.7	2.1	3.4	7.5	11.6	388
Completed primary education	56.4	13.3	4.5	4.6	3.0	9.7	8.4	4489
Incomplete secondary education	50.7	17.3	5.3	9.3	5.3	5.3	6.7	75
training after secondary education	47.0	9.7	5.1	11.9	2.1	13.6	10.6	236
Secondary or higher	47.8	16.4	5.4	7.9	2.6	12.6	7.4	1135
Malaria epidemiological strata								
Very Low	15.9	21.0	4.6	17.3	9..0	9.0	23.1	1130
Low	32.1	21.1	7.2	6.1	2.1	19.6	11.8	1607
Moderate	62.0	13.9	4.7	2.5	2.3	8.5	6.2	1643
Very high	81.7	4.7	3.4	1.0	1.0	5.4	2.8	2404
Geographical zone								
Central	33.0	23.7	7.0	9.1	2.6	11.4	13.3	782
Eastern	51.9	15.4	2.9	4.5	0.6	15.9	8.8	1106
Lake	79..0	5.8	2.2	0.8	1.7	6.4	4	1660
Northern	29.8	17.3	4.5	16.5	1.1	10.2	20.5	925
Southern Highlands	34.5	23.5	7.0	4.5	13.2	8.5	8.8	600
Southwest Highlands	40.3	16	10.7	4.0	5.5	14.3	9.2	775
Southern	73.7	5.3	3.2	1.3	0.3	9.6	6.6	376
Western	81.9	4.0	5.0	1.4	1.4	4.0	2.2	626
Region								
Arusha	7.1	26.2	5.2	34.8	0.0	8.3	18.5	325
Dar es Salaam	33.2	18.9	2.9	6.9	0.5	24.6	12.9	549
Dodoma	32.7	27.0	4.3	13.3	2.5	12.6	7.6	278
Geita	81.6	2.0	3.7	1.6	2.0	3.3	5.7	245

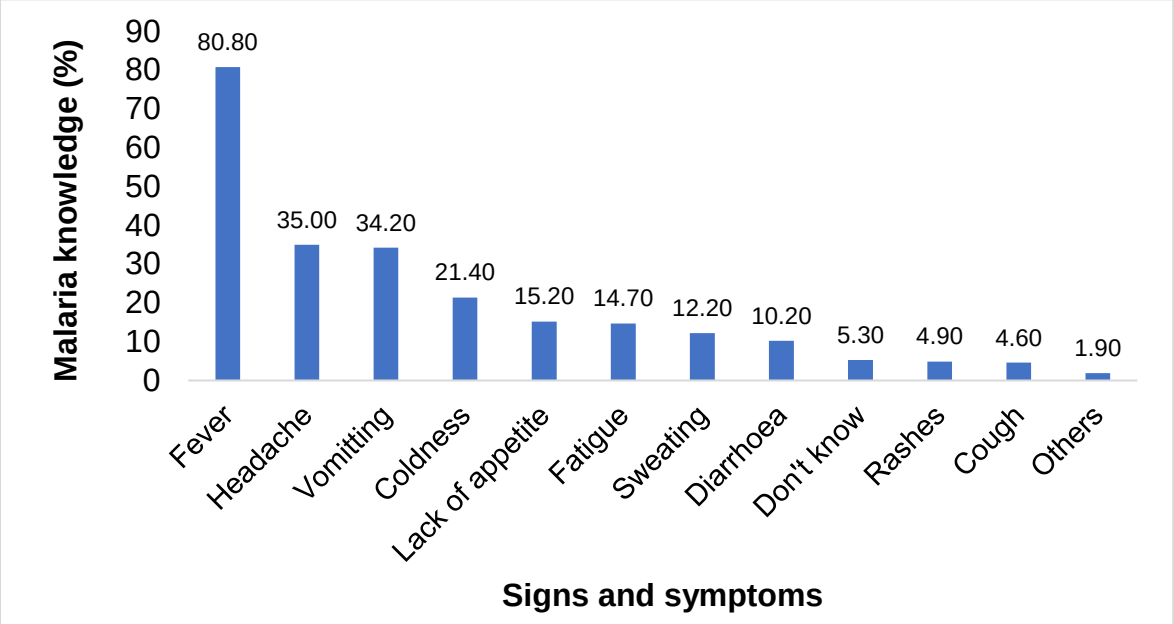
BACKGROUND CHARACTERISTICS	MALARIA	FLU	DIARRHOEA	CANCER, TUBERCULOSISCARDIAC DISEASE, DIABETES	HIV/AIDS	OTHERS	DON'T KNOW	NUMBER OF HOUSEHOLDS
Iringa	24.9	28.3	9.8	2.9	1.2	17.9	15	173
Kagera	83.4	6.3	0.6	0.9	1.1	4.9	2.9	349
Katavi	71.4	6.3	7.1	0.8	8.7	3.2	2.4	126
Kigoma	72.2	7.2	8.6	2.4	0.3	7.2	2.1	291
Kilimanjaro	9.5	19.4	6.1	12.2	1.0	15.3	36.4	294
Lindi	82.2	6.8	3.4	1.4	0.7	4.8	0.7	146
Manyara	31.9	17.1	6	9.4	1.0	12.8	21.8	298
Mara	83.6	3.1	2.4	0.3	0.7	7.0	2.8	287
Mbeya	43.5	29.4	9.8	5.6	2.3	7.0	2.3	214
Morogoro	70.9	10.9	3.1	2.9	0.9	6.9	4.6	350
Mtwara	68.3	4.3	3.0	1.3	0.0	12.6	10.4	230
Mwanza	65.2	9.4	3.1	0.8	2.3	14.0	5.2	385
Njombe	10.5	27.4	7.9	4.7	38.9	0.5	10	190
Pwani	69.6	13.5	2.4	1.0	0.5	8.2	4.8	207
Rukwa	28.3	13.6	18.0	3.3	1.8	24.6	10.3	272
Ruvuma	60.8	16.9	4.2	5.5	1.3	8.0	3.4	237
Shinyanga	82.6	7.4	1.6	1.6	1.1	2.1	3.7	190
Simiyu	84.8	5.4	1.5	0.0	2.9	2.0	3.4	204
Singida	35	28.6	12.1	2.9	4.9	7.8	8.7	206
Songwe	31.9	9.8	2.5	5.5	13.5	15.3	21.5	163
Tabora	90.4	1.2	1.8	0.6	2.4	1.2	2.4	335
Tanga	73.5	5.9	2.3	1.3	2.3	7.2	7.5	306

Household knowledge of signs and symptoms of malaria

A total of 6,824 households were interviewed on their knowledge of signs and symptoms of malaria. The most frequently mentioned symptoms were fever (80.8%), headache (35.0 %) and vomiting (34.2%). Cough was less mentioned as a sign of malaria (4.6%) (**Figure 16).**

Figure 16. Reported malaria signs and symptoms among heads of households

Level of education



The results reveal that knowledge of malaria symptoms and signs increased with an increase in education level of the household respondents**,** ranging from 68.4% in those with no education to 85.4% in those with secondary or higher education level (**Table 12).**

Malaria epidemiological strata

Across all epidemiological strata, most respondents identified fever as a symptom for malaria. Fever was highly reported as a malaria symptom among respondents in high 82.8% and moderate (80.9%) strata compared to low (79.4%) and very low strata (77.6%). Other symptoms, including headache, vomiting and shivers, were reported by less than 50% of the respondents across all strata.

Geographical zone

More than 70% of respondents across geographical zones reported fever as a symptom of malaria. Vomiting was also mentioned by one-third of the respondents across geographical zones.

Regions

More than 50% of household respondents across all regions reported fever as a malaria symptom, with the higest proportions being in the Kagera region (92.2%) and the lowest in Iringa (66.1%).

Table 12: Reported malaria signs and symptoms among households' heads

BACKGROUND CHARACTERISTICS	FEVER	COLDNESS	RASHES	SWEATING	HEADACHE	LACK OF APPETITE	VOMITING	DIARRHOEA	FATIGUE	COUGH	OTHER	DON'T KNOW	TOTAL
Highest level of education of the household head													
No education	68.4	18.4	4.6	11.1	29.7	10.7	27.6	7.7	7.5	4.6	3.1	12.1	522
Incomplete primary education	76.4	19.7	3.1	10.9	30.1	15.8	30.6	10.4	12.4	5.2	2.8	8	386
Completed primary education	81.6	20.8	4.5	11.4	33.6	13.6	33.1	9.7	14	4.3	1.8	5.3	4485
Incomplete secondary education	81.9	26.4	12.5	16.7	40.3	29.2	40.3	11.1	6.9	4.2	1.4	0	72
training after secondary education	77.6	27.8	5.5	13.9	43	21.5	38.8	13.1	21.5	6.8	3.4	3.4	237
Secondary or higher	85.4	24.3	6.4	15.7	42.8	21.3	41.4	12.9	20.6	5.2	1.4	1.8	1122
Marital status of the household head													
Married	82.1	21.9	4.9	12.2	34.8	15.6	34.2	10.6	14.9	4.9	1.9	4.8	5418
Single	81.3	16.7	3.3	8.7	40.7	12	43.3	8	16.7	2	0.7	6	150
Never married	72.7	22.7	0	18.2	50	13.6	31.8	9.1	9.1	0	0	4.5	22
Widow/widower	75.8	18.8	4.8	12.6	35.2	13.2	33.6	9.8	13.6	6	1.4	10.6	500
Separated	77.2	20.3	4.4	9.6	34.6	14	36.3	10.2	12.9	3.6	1.9	4.9	364
Cohabiting	71.9	20.3	5.6	16.1	34.7	15	30	6.1	13.3	0.8	4.2	5	360
I don't know	70	20	0	0	0	10	20	10	10	0	0	10	10
Malaria epidemiological strata													
Very low	77.6	23.6	8.3	20.4	33.5	18.9	31.7	10.5	12.6	7.1	1.9	9.2	1138
Low	79.4	19.6	5.6	11.4	35.9	17	31.5	11.6	16.4	5.5	1.6	7.1	1625
Moderate	80.9	24.7	4.4	11.6	34.3	14.6	38.9	10.2	17	3.9	2.3	3.5	1621
Very high	82.8	19.5	3.1	9.2	35.5	12.7	33.6	8.9	12.8	3.2	2	3.4	2378
Geographical zone													

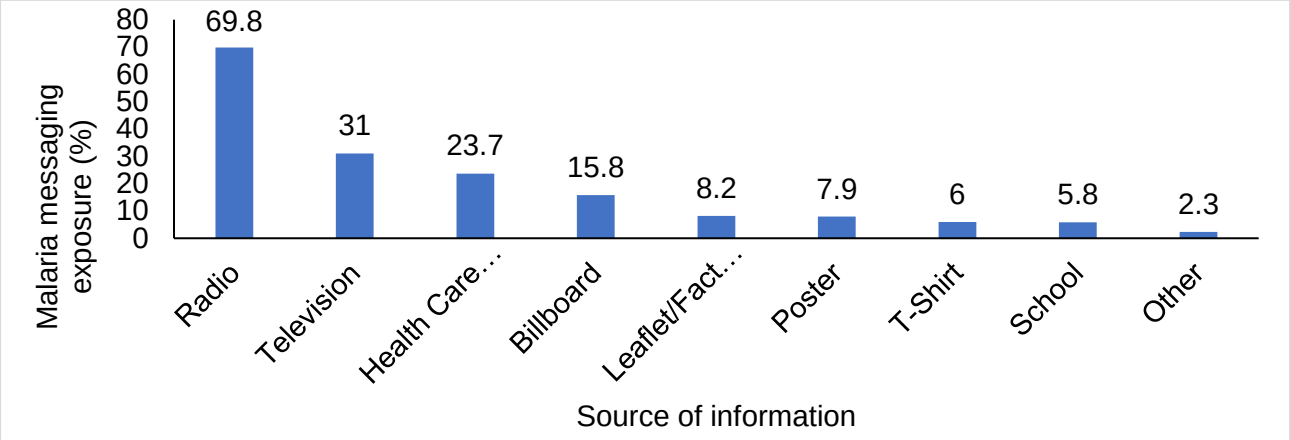
BACKGROUND CHARACTERISTICS	FEVER	COLDNESS	RASHES	SWEATING	HEADACHE	LACK OF APPETITE	VOMITING	DIARRHOEA	FATIGUE	COUGH	OTHER	DON'T KNOW	TOTAL
Central	82.5	24.3	6.6	15.1	29	12.2	32.7	12.7	13	6.6	1.3	7.1	787
Eastern	84.1	14.5	2.3	9.2	38.4	19.6	40.8	12.1	14.4	4.9	1.4	3.5	1109
Lake	84.3	17.7	2.7	8.9	33.6	13.3	32.4	10.8	16.7	3.3	1.8	3.5	1612
Northern	72.5	26.1	7.9	16.4	40.9	20.8	32.5	10.6	12.2	7.1	3	9.4	934
Southern Highlands	75.4	17.5	2	11.5	24.3	14	28.6	9	16.5	2.5	2	7	601
Southwest Highlands	82.7	23.8	10.2	15.4	29.8	11.1	29.4	9.7	15.1	4.2	2.6	6.9	781
Southern	80.9	13.3	3.7	4.5	44.7	10.4	50.5	8.8	17.3	2.1	3.5	3.2	376
Western	78.8	38.5	5.1	17.3	42	16.8	32.7	4.6	11.7	5	1	1.9	624
Region													
Arusha	69.5	28.4	7.9	24.8	43.8	27.8	28.1	8.8	19.9	9.7	3	10.9	331
Dar es Salaam	84.8	12.2	2.2	7.6	45.7	23.8	37	11.4	12.9	6.5	0.9	4	551
Dodoma	85.4	31.7	8.4	18.8	32.1	17.8	30.3	5.9	21.6	4.9	0	2.4	287
Geita	82	21.8	2.9	13	27.6	12.1	34.7	16.3	10.9	4.2	1.3	4.2	239
Iringa	66.1	20.7	1.7	7.5	20.7	11.5	20.7	10.3	9.8	2.3	2.3	8.6	174
Kagera	92.2	25.7	5.2	7.5	39.3	14.5	28	11.8	15.9	1.7	2.6	2.9	346
Katavi	88.9	15.9	4	11.9	35.7	9.5	19.8	4.8	17.5	4	0	2.4	126
Kigoma	82.6	45.1	4.5	21.5	42.4	19.1	36.8	4.2	11.8	3.8	1.4	3.1	288
Kilimanjaro	70.3	18.3	6.3	12.3	30	15.3	26.7	6.7	3.3	5	3.3	11.3	300
Lindi	87	21.2	5.5	6.8	41.1	11.6	52.1	11	23.3	4.8	0.7	2.7	146
Manyara	80.8	22.6	6.4	16.8	27.3	9.4	31.3	15.8	7.4	5.7	0.3	11.4	297
Mara	75.7	11.6	1.1	14.1	30.4	10.1	26.4	8	12.3	3.6	3.6	4	276
Mbeya	81.4	15.3	9.8	17.7	24.2	9.8	33	12.1	14.9	7	1.9	7.9	215
Morogoro	81.9	18.6	3.4	12	34.1	13.8	50.7	12	15.5	2.3	2.3	1.7	349
Mtwara	77	8.3	2.6	3	47	9.6	49.6	7.4	13.5	0.4	5.2	3.5	230

BACKGROUND CHARACTERISTICS	FEVER	COLDNESS	RASHES	SWEATING	HEADACHE	LACK OF APPETITE	VOMITING	DIARRHOEA	FATIGUE	COUGH	OTHER	DON'T KNOW	TOTAL
Mwanza	87.5	11.4	3.3	5.4	39	11.9	42.3	13.8	23.8	2.2	0.5	3	369
Njombe	74.7	22.6	2.6	17.9	26.3	20.5	24.7	2.1	22.1	2.6	0	10	190
Pwani	86.1	13.9	1	8.6	26.3	18.2	34.4	13.9	16.7	4.8	1	5.3	209
Rukwa	82.4	37.1	9.6	9.9	33.1	9.2	29.8	9.9	14	2.6	5.1	5.9	272
Ruvuma	82.7	11	1.7	9.3	25.3	10.5	37.6	13.5	16.9	2.5	3.4	3.4	237
Shinyanga	80.1	9.7	0	8.1	33.9	22	34.9	5.9	21	1.6	1.1	2.2	186
Simiyu	83.2	26.5	1.5	6.6	25	11.7	25	5.1	13.8	8.2	1.5	5.6	196
Singida	80.8	16.3	4.4	7.4	27.1	8.4	37.9	17.7	8.9	10.3	4.4	7.4	203
Songwe	80.4	19	16.7	23.8	27.4	17.3	31.5	10.1	15.5	3.6	1.2	10.7	168
Tabora	75.6	32.7	5.7	13.7	41.7	14.9	29.2	5.1	11.6	6	0.6	0.9	336
Tanga	77.9	31.4	9.6	11.2	48.5	18.5	43.2	16.5	12.5	6.3	2.6	5.9	303
Total	**80.8**	**21.4**	**4.9**	**12.2**	**35**	**15.2**	**34.2**	**10.2**	**14.7**	**4.6**	**1.9**	**5.3**	**6824**

3.7 Exposure to malaria messages at household level

Overall, 5,529 household respondents were interviewed on exposure to malaria messages. Radio was the most mentioned source of messaging respondents were exposed to, at 69.8%, followed by television at 31.0%. T-shirts (6.0%) and school (5.8%) were the least-mentioned sources of messaging respondents were exposed to, as indicated in Figure 17. A similar trend was observed across education level, marital status, epidemiological strata and geographical zone as well as regions.

Figure 17. Household sources of information and exposure to malaria messages

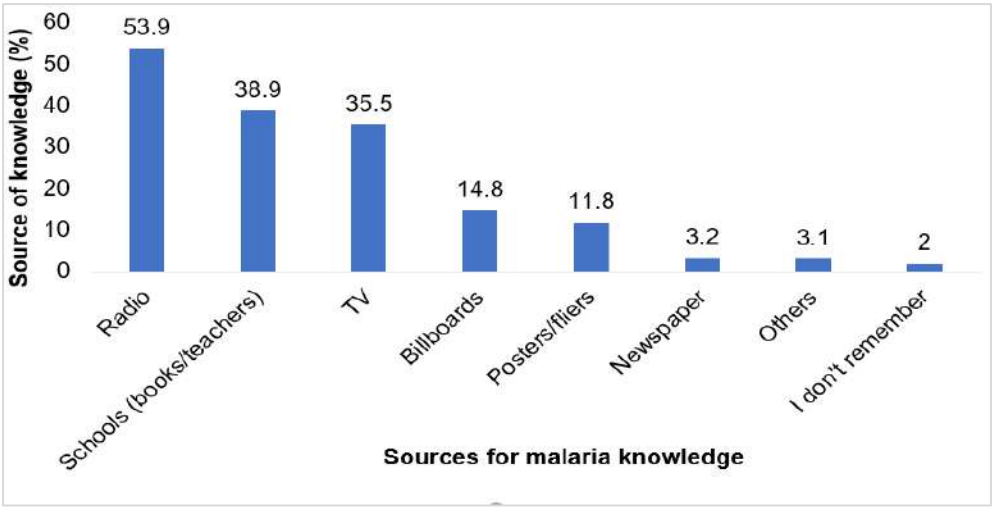


3.8 Exposure to malaria messages among SAC

Preventive messages

A total of 14,984 SAC aged 9–16 years were interviewed on their exposure to malaria prevention messages through various media sources. Overall, 49.4% of the SAC were exposed to information on malaria prevention methods through various media sources. The most mentioned medium was radio (53.9%), followed by schools (38.9%), television (35.5%), billboards (14.8%) and posters (11.8%). Newspapers were the least mentioned source of malaria messaging amongst SAC at 3.2% **(**Figure 18**).**

Figure 18. Exposure to preventive messages



Age and gender

Almost 50% of the SAC interviewed were exposed to malaria preventive messages; 49.2% of boys and 49.7% of girls were exposed. Exposure also varied by age groups where older SAC (13–16 years) had higher exposure (58.2%) compared to younger SAC (9–12 years) (46.8%) (**Table 13**).

Mosquito net ownership and use

A more than two-fold higher proportion of SAC who heard malaria preventive messages owned a mosquito net at home, compared to 21.2% of SAC who were exposed to malaria preventive massages but did not have a mosquito net (**Table 13**).

Malaria results

A similar proportion of SAC with malaria positive results (49.9%) and those without malaria (49.4%) were exposed to malaria prevention messages (**Table 13).**

Elevation

Exposure to preventive messages increased with decreasing altitude, where the highest exposure of 53.4% was recorded among SAC residing in areas below 750m (asl), and the lowest exposure of 40.1% was recorded among SAC residing in areas above 1750m (asl) (**Table 13)**.

Malaria epidemiological strata

SAC residing in moderate malaria epidemiological strata had high exposure of 53.8% to preventive messages as compared to SAC from low, high and very low epidemiological strata at 52.0%, 49.0% and 40.8%, respectively (**Table 13**).

Geographical zones

Exposure to malaria preventive massages varied across geographical zones, ranging from 37.8% to 59.0% in the Northern and Eastern zones, respectively. The Eastern, Western, Central, Lake and Southern zones recorded exposure of above 50.0%; other zones recorded exposure of below 50.0% (**Table 13**).

Regions

Exposure to malaria preventive massages by region ranged from 29.3% to 61.4% in Rukwa and Pwani, respectively; 42.3% (11/26) of the regions reported more than half (50%) of the SAC were exposed to malaria preventive messages through various media sources (**Table 13**).

Table 13: Exposure to malaria prevention messages

BACKGROUND CHARACTERISTICS	SAC EXPOSED TO MALARIA PREVENTION MESSAGES (%)	NUMBER OF SAC INTERVIEWED	SOURCE OF EXPOSURE TO MALARIA PREVENTION MESSAGES (%)							NUMBER OF SAC EXPOSED TO MALARIA PREVENTION MESSAGES
			TV	RADIO	BILLBOARDS	NEWSPAPER	POSTERS/ FLIERS	SCHOOL, BOOKS, TEACHERS	OTHERS	
Total	**49.4**	**14984**	**35.5**	**53.9**	**14.8**	**3.2**	**11.8**	**38.9**	**3.1**	**7407**
Gender										
Girls	49.7	7353	36.2	53.9	15.3	3.2	11.8	39.5	2.7	3651
Boys	49.2	7631	34.9	53.9	14.4	3.2	11.7	38.4	3.5	3756
Age										
9 -12	46.8	11530	36.8	53.6	14.5	3.2	11.3	38.7	3.0	5396
13 -16	58.2	3454	32.1	54.7	15.6	3.2	13	39.4	3.4	2011
Do have a mosquito net at home?										
Yes	56	12139	35.8	54.2	15.2	3.2	11.9	38.9	3.2	6803
No	21.2	2845	32.3	50.3	10.6	3.5	10.9	39.7	1.7	604
Did you sleep under a mosquito net last night?										
Yes	58.1	10484	36.9	54.6	15.7	3.4	12.3	38.3	3.2	6091
No	43	1655	26.1	50.6	11	1.1	8.1	43.8	3.5	712
Malaria results										
Positive	49.9	1935	20.7	59.1	14.9	2.1	13.6	40.2	2.5	965
Negative	49.4	13049	37.7	53.1	14.8	3.4	11.5	38.7	3.2	6442
Distance of the school from the nearby health facility										
less than 5km	49.6	7424	38.7	55.8	15	3.5	10.5	35.5	2.8	3681
5 km or more	49.3	7560	32.4	52	14.7	2.9	13	42.3	3.4	3726
Elevation										

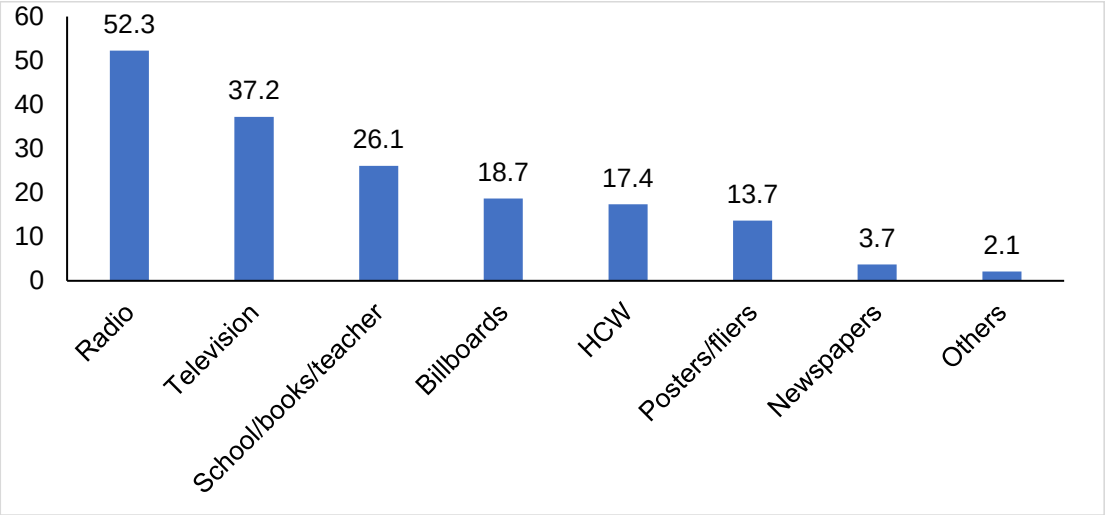
BACKGROUND CHARACTERISTICS	SAC EXPOSED TO MALARIA PREVENTION MESSAGES (%)	NUMBER OF SAC INTERVIEWED	SOURCE OF EXPOSURE TO MALARIA PREVENTION MESSAGES (%)							NUMBER OF SAC EXPOSED TO MALARIA PREVENTION MESSAGES
			TV	RADIO	BILLBOARDS	NEWSPAPER	POSTERS/ FLIERS	SCHOOL, BOOKS, TEACHERS	OTHERS	
Below 750m	53.4	4842	40.5	56.9	14.6	3.1	11.3	35	3.4	2585
75–1250m	49.2	5476	34.8	54.2	14.5	2.8	11	36.6	2.5	2692
1250–1750m	46.7	3957	30.7	50.2	17.4	4.1	14.2	45	3.3	1846
Above 1750	40.1	709	27.8	48.2	3.5	2.1	8.5	57	4.2	284
Malaria epidemiological strata										
Very low	40.8	2509	38.8	56.8	12.2	2.9	14.1	46.8	2.6	1024
Low	52	3511	49.4	53.3	15.2	5.7	11.7	39	2.2	1827
Moderate	53.8	3365	33.8	54.6	12.9	1.8	10.4	36.1	2.5	1810
Very high	49	5599	26.2	52.7	16.9	2.5	11.9	37.8	4.2	2746
Geographical zone										
Eastern	59	2428	49.2	61.6	14.8	2.7	9.5	34.5	2.9	1432
Western	53.8	1475	28.1	55	9	2.9	10.8	43.4	3.8	793
Central	51.2	1891	37.3	59.6	16.1	5.5	13.6	40.4	2.1	969
Lake	50.5	3681	27.7	49.9	16.3	1.5	10.4	37.4	2.5	1859
Southern	50.3	858	23.8	57.9	13.7	3.5	13	34.5	7.2	432
Southern Highlands	47.5	1211	31.5	45	7.1	3	9.9	46.1	4.3	575
Southwest Highlands	41.1	1425	27.4	46.2	15.9	2.2	15.7	40.2	3.1	585
Northern	37.8	2015	50.3	51.2	21.5	6.4	15.9	40.7	2.1	762
Region										
Pwani	61.4	477	38.9	72.4	20.5	2	11.3	35.8	3.4	293
Mwanza	60.6	827	40.7	60.3	13.6	1.2	10	30.7	1.4	501
Dar es Salaam	60.1	1242	55.5	52.1	11	3.2	11.7	38.6	3.1	746
Shinyanga	59.8	453	21	32.5	12.5	1.1	4.1	57.6	1.8	271

BACKGROUND CHARACTERISTICS	SAC EXPOSED TO MALARIA PREVENTION MESSAGES (%)	NUMBER OF SAC INTERVIEWED	SOURCE OF EXPOSURE TO MALARIA PREVENTION MESSAGES (%)							NUMBER OF SAC EXPOSED TO MALARIA PREVENTION MESSAGES
			TV	RADIO	BILLBOARDS	NEWSPAPER	POSTERS/ FLIERS	SCHOOL, BOOKS, TEACHERS	OTHERS	
Dodoma	56.9	706	47.8	65.4	16.7	10	9.5	29.4	1.5	402
Tabora	56.5	797	32	67.6	6.9	2.9	12.9	34	1.8	450
Morogoro	55.4	709	45	71.5	17.8	2	4.1	25.7	2	393
Lindi	54.6	350	28.8	61.3	22.5	3.1	22	22.5	3.7	191
Katavi	53.4	290	25.2	43.9	15.5	3.9	22.6	30.3	2.6	155
Mara	51.8	593	20.2	48.9	16.3	3.9	18.6	40.1	2.6	307
Kigoma	50.6	678	23	38.5	11.7	2.9	8.2	55.7	6.4	343
Manyara	49.8	713	30.4	60.3	16.3	2.8	22.3	58.3	0.6	355
Njombe	48.9	401	31.1	49	1.5	3.1	6.6	52.6	2.6	196
Mtwara	47.4	508	19.9	55.2	6.6	3.7	5.8	44	10	241
Ruvuma	47.1	493	38.4	36.6	15.9	3.4	17.7	40.5	7.3	232
Iringa	46.4	317	21.1	53.1	0.7	2	2	46.3	2	147
Geita	45.9	538	15.0	46.6	15.4	0.4	13.8	49.4	2.4	247
Simiyu	45.8	498	18.0	63.6	11.4	0.9	6.1	32	2.2	228
Mbeya	45.3	417	38.1	51.9	18.5	2.6	22.8	39.7	0.5	189
Singida	44.9	472	28.8	47.6	14.6	1.4	7.1	31.1	5.7	212
Arusha	41.4	722	62.9	45.2	30.4	5.4	25.4	43.1	1	299
Kagera	39.5	772	37.4	41.6	28.5	1.3	8.9	22	5.2	305
Songwe	39	315	21.1	34.1	20.3	1.6	10.6	50.4	1.6	123
Tanga	38.8	672	44.1	53.3	23.4	11.9	13	36.8	2.7	261
Kilimanjaro	32.5	621	39.6	57.4	5.9	1.0	5.4	42.1	3	202
Rukwa	29.3	403	19.5	52.5	7.6	0	0.8	43.2	9.3	118

3.9 Exposure to malaria testing messages among SAC

A total of 14,984 SAC reported their exposure to malaria testing massages through various media sources. Overall, 34.3% of the SAC were exposed to malaria testing messages. Radio was the most frequently (52.3%) mentioned source of exposure, followed by television 37.2%, and the least mentioned source of exposure was newspaper (3.7%) **(Figure 19).**

Figure 19. Sources of malaria testing messages



Age and gender

One-third of the interviewed SAC were exposed to malaria testing messages, where 34.0% of boys and 34.7% of girls were exposed. Exposure also varied across age groups; 41.3% of older SAC (13–16 years) were exposed to malaria testing messages compared to 32.3% of SAC aged 9–12 years old (**Table 14**)

Elevation

Exposure to testing messages increased with decreasing altitude, where the highest exposure (40.4%) to malaria testing messages was recorded in areas below 750m (asl), and the lowest exposure (22.0%) to malaria treatment messages was recorded amonst SAC residing at above 1750m (asl) (**Table 14**).

Malaria epidemiological strata

Exposure to malaria testing messages was higher among SAC residing in high (36.6%) and moderate (37.2%) malaria epidemiological strata compared to low (33.7%) and very low (26.3%) malaria epidemiological strata **(Table 14).**

Geographical zones

Across various geographical zones the highest exposure to malaria testing messages was recorded among SAC residing in the Eastern zone (42.0%); the lowest proportion of SAC exposed was recorded in Southwest Highlands (**Table 14**).

Regions

SAC residing in Lindi had relatively higher exposure (50.3%) to malaria testing messages compared to SAC in Rukwa who had an exposure rate of 13.6% (**Table 14**).

Table 14: Exposure to malaria testing messages

BACKGROUND CHARACTERISTICS	PUPILS EXPOSED TO MALARIA TESTING MESSAGES (%)	NUMBER OF PUPILS INTERVIEWED	SOURCE OF MALARIA TESTING MESSAGES (%)								NUMBER OF PUPILS EXPOSED TO MALARIA TESTING MESSAGES
			TV	RADIO	BILLBOARDS	NEWSPAPERS	POSTERS/FLIERS	SCHOOL, BOOKS, TEACHER	HEALTH CARE WORKERS	OTHERS	
Total	**34.3**	**14984**	**37.2**	**52.3**	**18.7**	**3.7**	**13.7**	**26.1**	**17.4**	**2.1**	**5145**
Malaria test results											
Negative	34	13049	40.1	51.7	18.7	4.0	13.4	25.4	17.5	2.0	4440
Positive	36.4	1935	19.1	56.2	18.7	2.1	15.6	30.8	16.3	2.6	705
Gender											
Girls	34.7	7353	36.6	51.5	18.1	4.1	14.0	26.1	18.4	1.9	2551
Boys	34	7631	37.8	53.1	19.3	3.4	13.4	26.1	16.3	2.3	2594
Age											
9–12	32.3	11530	38.1	52.7	18.7	3.6	13.2	26.0	16.9	2.1	3719
13–16	41.3	3454	34.9	51.4	18.6	4.1	14.9	26.5	18.5	2.2	1426
Do have a mosquito net at home?											
Yes	38.7	12139	37.3	52.5	19.0	3.8	13.8	26.3	17.3	2.2	4692
No	15.9	2845	36.6	51.2	15.2	2.6	12.4	24.7	17.7	1.1	453
Did you sleep under a mosquito net last night?											
Yes	40.6	10484	37.7	53.1	19.3	4.0	14.3	26.1	17.3	2.1	4257
No	26.3	1655	32.4	46.0	16.3	2.5	9.4	28.3	17.2	3.2	435
Distance of the school from the nearby health facility											
Less than 5km	33.5	7424	40.9	53.0	19.5	3.9	12.6	23.9	16.9	2.2	2489
5km or more	35.1	7560	33.8	51.8	17.9	3.5	14.7	28.3	17.8	2.0	2656
Elevation											
Below 750m	40.4	4842	41.4	52.1	16.9	3.0	12.8	22.7	16.5	2.3	1954
750–1250m	33.1	5476	34.2	54.2	19.5	4.0	13.1	25.7	12.3	2.4	1812

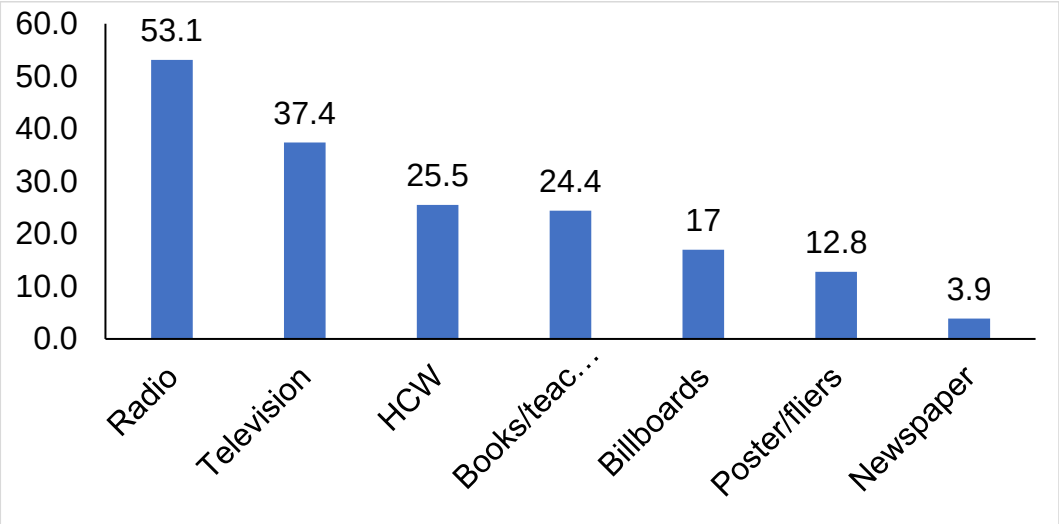
BACKGROUND CHARACTERISTICS	PUPILS EXPOSED TO MALARIA TESTING MESSAGES (%)	NUMBER OF PUPILS INTERVIEWED	SOURCE OF MALARIA TESTING MESSAGES (%)								NUMBER OF PUPILS EXPOSED TO MALARIA TESTING MESSAGES
			TV	RADIO	BILLBOARDS	NEWSPAPERS	POSTERS/FLIERS	SCHOOL, BOOKS, TEGUED	HEALTH CARE WORKERS	OTHERS	
1250–1750m	30.9	3957	35.3	49.4	21.7	4.8	16.3	31.1	25.8	1.5	1223
Above 1750	22	709	34.6	56.4	7.7	1.9	10.3	35.9	21.8	1.3	156
Malaria epidemiological strata											
Very low	26.3	2509	43.1	57.5	17.4	2.7	16.2	28.4	26.9	0.8	661
Low	33.7	3511	54.6	46.8	22.1	7.9	16.5	23.8	15.4	1.8	1183
Moderate	37.2	3365	33.5	55.4	16.0	1.8	10.6	24.1	14.2	2.9	1252
Very high	36.6	5599	27.5	52.0	18.8	2.8	13.1	28.0	17.3	2.2	2049
Geographical zone											
Central	37	1891	35.3	52.1	22.0	8.3	19.3	31.8	24.7	1.7	699
Eastern	42	2428	51.5	54.6	16.1	2.4	10.3	20.6	16.2	1.8	1020
Lake	36.4	3681	27.2	52.1	20.5	1.4	12.6	25.7	14.0	2.2	1339
Northern	27	2015	54.2	47.6	30.0	6.8	17.1	32.5	21.7	1.5	544
Southern Highlands	26.6	1211	36.0	53.1	7.5	3.4	4.3	27.0	14.9	4.7	322
Southwest Highlands	22.5	1425	28.4	46.6	16.3	2.2	19.7	15.9	11.9	1.3	320
Southern	40.4	858	26.5	49.0	19.0	4.6	17.6	24.8	22.2	3.5	347
Western	37.6	1475	33.2	58.8	11.6	3.6	11.6	30.3	15.5	1.6	554
Region											
Lindi	50.3	350	33.0	50.0	26.1	5.7	26.7	15.9	15.9	1.7	176
Pwani	48.8	477	39.1	71.7	19.7	2.1	9.4	34.3	27.5	0.0	233
Mara	46.7	593	17.7	48.7	19.1	2.9	18.4	25.6	24.2	2.2	277
Tabora	42.7	797	35.9	68.8	10.3	2.1	10.0	22.9	11.2	1.2	340
Dar es Salaam	42.6	1242	63.5	40.3	14.7	2.8	13.0	17.4	16.1	2.5	529
Mwanza	42.4	827	38.7	61.5	21.4	0.6	12.5	19.4	10.3	2.6	351

BACKGROUND CHARACTERISTICS	PUPILS EXPOSED TO MALARIA TESTING MESSAGES (%)	NUMBER OF PUPILS INTERVIEWED	SOURCE OF MALARIA TESTING MESSAGES (%)								NUMBER OF PUPILS EXPOSED TO MALARIA TESTING MESSAGES
			TV	RADIO	BILLBOARDS	NEWSPAPERS	POSTERS/FLIERS	SCHOOL, BOOKS, TEGUED	HEALTH CARE WORKERS	OTHERS	
Dodoma	39.4	706	45.0	53.6	24.5	15.1	15.1	22.3	12.6	3.6	278
Manyara	38.8	713	29.2	53.4	19.1	4.7	28.9	45.5	43.7	0.0	277
Morogoro	36.4	709	38.0	68.6	15.5	1.6	5.4	14.7	6.2	1.9	258
Ruvuma	35.7	493	29.0	39.2	13.1	4.5	7.4	27.8	23.9	8.0	176
Shinyanga	35.3	453	23.8	41.3	18.1	0.0	5.6	38.1	5.6	0.0	160
Tanga	33.8	672	46.7	48.0	29.5	13.2	14.1	36.1	15.4	3.1	227
Mtwara	33.7	508	19.9	48.0	11.7	3.5	8.2	33.9	28.7	5.3	171
Simiyu	33.5	498	18.6	63.5	10.2	2.4	4.8	16.2	12.0	5.4	167
Geita	32.3	538	15.5	50.0	23.0	0.6	19.0	43.7	14.9	0.6	174
Kigoma	31.6	678	29.0	43.0	13.6	6.1	14.0	42.1	22.4	2.3	214
Katavi	31.4	290	27.5	46.2	19.8	1.1	28.6	9.9	5.5	1.1	91
Singida	30.5	472	28.5	46.5	22.9	2.1	9.0	23.6	11.8	1.4	144
Arusha	27.7	722	67.0	44.0	41.0	3.5	26.5	32.5	29.0	0.0	200
Kagera	27.2	772	39.5	41.4	29.0	1.9	11.4	19.5	14.3	2.4	210
Mbeya	26.6	417	28.8	50.5	10.8	1.8	25.2	13.5	11.7	0.0	111
Njombe	20.9	401	40.5	76.2	1.2	2.4	1.2	23.8	4.8	0.0	84
Songwe	20	315	36.5	44.4	23.8	4.8	11.1	22.2	12.7	3.2	63
Iringa	19.6	317	50.0	61.3	0.0	1.6	0.0	29.0	3.2	1.6	62
Kilimanjaro	18.8	621	47.0	53.0	12.0	0.0	6.8	25.6	21.4	0.9	117
Rukwa	13.6	403	20.0	41.8	12.7	1.8	3.6	23.6	21.8	1.8	55

3.10 Exposure to malaria treatment messages among SAC

A total of 14,984 SAC were interviewed to determine their exposure to malaria treatment messages through various media sources. Overall, the rate of exposure to malaria treatment messages was 33.0%. Radio was the most mentioned source at 53.1%, followed by television (37.4%), and the least mentioned was newspaper at 3.9% (**Figure 20**).

Figure 20. Sources of malaria treatment messages



Age and gender

A comparable proportion of boys (33.2%) and girls (32.9%) were exposed to malaria treatment messages through various media sources. Age wise, exposure was higher (39.6%) in older SAC (13–16 years) than in the younger age group (31.1%) (**Table 15**).

Elevation

Findings indicate SAC residing in areas below 750m (asl) were more exposed (39.2%) to malaria testing messages than SAC residing in altitudes above 750m asl (**Table 15**).

Malaria epidemiological strata

Exposure to malaria treatment messages ranged from 25.1% for SAC residing in very low to 36.0% in very high malaria epidemiological strata (**Table 15**).

Geographical zones

Across various geographical zones, the highest proportion of SAC exposed to malaria treatment messages was in the Eastern zone (43.2%), and the least in Southwest Highlands (17.1%) (**Table 15**).

Regions

The region with highest proportion of SAC exposed to malaria treatment messages was Pwani at 50.9%, and the least proportion of SAC exposed to such messages was in Rukwa at 10.2% (**Table 15**).

Table 15: Exposure to malaria treatment messages

BACKGROUND CHARACTERISTICS	SAC EXPOSED TO MALARIA TREATMENT MESSAGES	NUMBER OF SAC INTERVIEWED	SOURCE OF EXPOSURE TO MALARIA TREATMENT MESSAGES (%)								
			TV	RADIO	BILLBOARDS	NEWSPAPER	POSTER/ FLIER	HEALTH CARE	BOOKS/	OTHERS	TOTAL
Total	**33.0**	**14984**	**37.4**	**53.1**	**17.1**	**3.9**	**12.8**	**25.4**	**24.2**	**1.6**	**4950**
Gender											
Girls	33.2	7353	37.8	52.4	16.5	4.3	12.7	25.7	24.7	1.3	2439
Boys	32.9	7631	37.1	53.8	17.8	3.4	12.9	25.0	23.7	1.9	2511
Age											
9–12	31.1	11530	38.1	53.1	16.8	3.9	12.4	24.7	23.4	1.9	3582
13–16	39.6	3454	35.6	53.1	18.1	3.9	13.7	27.1	26.2	0.8	1368
Do have a mosquito net at home?											
Yes	37.4	12139	37.8	52.8	17.5	3.9	12.6	25.7	24.0	1.7	4545
No	14.2	2845	33.1	56.5	13.1	3.5	14.3	21.0	26.4	0.5	405
Did you sleep under a mosquito net last night?											
Yes	39.5	10484	38.3	53.4	17.9	4.0	12.9	25.9	23.5	1.6	4141
No	24.4	1655	32.9	47.0	13.4	3.2	9.4	24.0	28.5	2.5	404
Distance of the school from the nearby health facility											
less than 5km	31.9	7424	40.5	52.1	17.7	4.0	11.6	25.7	21.4	1.7	2365
5km or more	34.2	7560	34.6	54.1	16.6	3.8	13.8	25.1	26.8	1.5	2585
Elevation											
Below 750m	39.2	4842	40.2	53.0	14.2	3.5	11.2	23.4	23.6	2.1	1898
750–1250m	32.4	5476	35.6	53.8	17.8	3.5	11.5	24.8	20.7	1.5	1776
1250–1750m	29.1	3957	35.7	51.8	21.8	5.3	17.5	29.7	29.9	1.0	1150
Above 1750	17.8	709	37.3	57.9	9.5	0.8	11.1	22.2	30.2	0.8	126
Malaria epidemiological strata											
Very low	25.1	2509	42.9	57.5	14.6	4.4	16.7	25.6	33.5	1.4	630

BACKGROUND CHARACTERISTICS	SAC EXPOSED TO MALARIA TREATMENT MESSAGES	NUMBER OF SAC INTERVIEWED	SOURCE OF EXPOSURE TO MALARIA TREATMENT MESSAGES (%)								
			TV	RADIO	BILLBOARDS	NEWSPAPER	POSTER/ FLIER	HEALTH CARE	BOOKS/	OTHERS	TOTAL
Low	32.9	3511	55.9	49.8	20.3	7.8	15.7	21.0	26.6	1.9	1155
Moderate	34.1	3365	34.3	55.4	13.9	1.7	8.8	25.5	19.1	1.2	1147
Very high	36.0	5599	27	52.4	17.9	2.7	12.1	27.8	22.8	1.7	2018
Geographical zone											
Eastern	43.2	2428	48.7	55.2	13.5	3.2	10.1	20.2	24.7	1.5	1048
Southern	38.5	858	22.7	50.9	16.7	4.5	14.5	28.8	25.5	5.2	330
Western	36.2	1475	33.9	63.3	7.9	2.1	12.7	26.2	29.4	0.6	534
Central	35.7	1891	37.9	55.3	22.3	7.8	16.9	25.9	32.5	0.9	676
Lake	35.2	3681	28.5	50.9	20.8	1.8	10.4	28.7	15.9	0.8	1294
Northern	26.0	2015	51.9	46.0	25.6	8.0	18.9	33.0	24.6	1.5	524
Southern Highlands	24.8	1211	37.7	54.3	7.0	3.7	8.0	16.0	27.0	4.7	300
Southwest Highlands	17.1	1425	31.6	44.7	14.3	0.8	15.6	16.8	25.0	2.0	244
Region											
Pwani	50.9	477	38.3	65.0	21.4	4.5	9.9	33.3	27.2	0.0	243
Lindi	46.0	350	29.2	57.1	23.6	6.8	19.9	28.6	18.6	0.0	161
Tabora	45.4	797	33.1	68.8	5.0	1.4	11.0	19.6	30.1	0.6	362
Dar es Salaam	44.8	1242	58.5	43.4	9.3	3.1	13.3	18.9	28.7	2.3	557
Mara	43.8	593	18.8	50.8	17.3	3.1	14.2	25.4	23.1	0.4	260
Mwanza	43.0	827	41.3	60.4	22.5	0.8	12.1	24.2	12.9	1.1	356
Manyara	39.7	713	32.9	56.5	19.1	5.7	27.6	35.7	55.1	0.4	283
Dodoma	36.5	706	48.4	58.1	23.6	12.4	8.9	19.0	17.4	0.8	258
Morogoro	35.0	709	36.7	72.2	14.9	2.4	3.2	10.5	13.3	1.2	248
Shinyanga	34.0	453	24.7	36.4	19.5	1.9	2.6	43.5	6.5	0.0	154
Ruvuma	33.7	493	31.3	39.8	11.4	4.2	13.9	24.1	30.1	7.2	166
Tanga	33.6	672	44.7	50.0	25.2	13.3	13.7	32.3	20.8	0.9	226
Mtwara	33.3	508	16.6	45.0	10.1	2.4	9.5	29.0	32.0	10.1	169

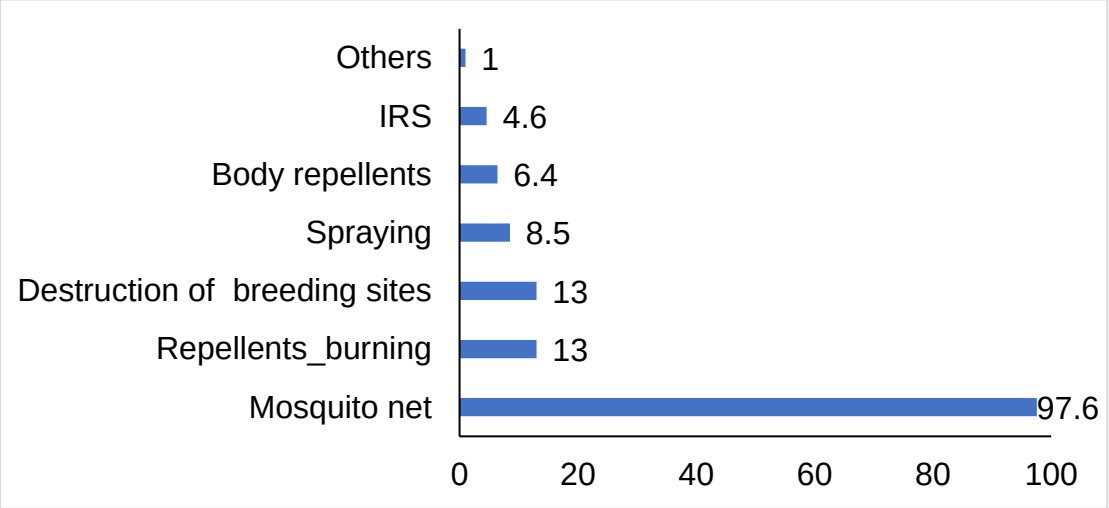
BACKGROUND CHARACTERISTICS	SAC EXPOSED TO MALARIA TREATMENT MESSAGES	NUMBER OF SAC INTERVIEWED	SOURCE OF EXPOSURE TO MALARIA TREATMENT MESSAGES (%)								
			TV	RADIO	BILLBOARDS	NEWSPAPER	POSTER/ FLIER	HEALTH CARE	BOOKS/	OTHERS	TOTAL
Simiyu	30.1	498	19.3	63.3	7.3	2.0	4.0	18.0	15.3	0.7	150
Kagera	29.5	772	37.3	39.0	30.7	2.2	7.5	24.6	13.2	1.8	228
Singida	28.6	472	28.1	47.4	26.7	3.7	9.6	18.5	14.1	2.2	135
Geita	27.1	538	14.4	48.6	22.6	0.7	19.2	47.3	25.3	0.0	146
Katavi	25.5	290	32.4	43.2	14.9	1.4	23.0	9.5	20.3	1.4	74
Kigoma	25.4	678	35.5	51.7	14.0	3.5	16.3	40.1	27.9	0.6	172
Arusha	24.5	722	65.5	39.5	38.4	5.6	33.3	39.0	28.8	2.8	177
Mbeya	20.9	417	36.8	50.6	14.9	0.0	11.5	18.4	19.5	0.0	87
Njombe	20.4	401	42.7	78.0	2.4	3.7	0.0	8.5	17.1	0.0	82
Kilimanjaro	19.5	621	45.5	47.9	7.4	1.7	7.4	25.6	25.6	0.8	121
Iringa	16.4	317	50	63.5	0.0	1.9	1.9	1.9	32.7	3.8	52
Songwe	13.3	315	23.8	42.9	14.3	2.4	23.8	28.6	38.1	2.4	42
Rukwa	10.2	403	26.8	36.6	12.2	0.0	2.4	14.6	31.7	7.3	41

3.11 Malaria knowledge amongst SAC

Knowledge of malaria prevention methods

A total of 14,984 SAC aged 9–16 years were interviewed to determine their awareness of malaria prevention methods. More than half of the SAC (68.7%) were aware of malaria prevention methods. The most cited malaria prevention method was a mosquito net at 97.6%, and the least mentioned method was the indoor residual spray (IRS) method (4.6%) (**Figure 21**).

Figure 21. Knowledge of malaria prevention methods amongst SAC



Age and sex

A comparable proportion of boys (69.3%) and girls (68.2%) were aware of malaria prevention methods. On the other hand, 78.4% of the older SAC aged 13–16 years were aware of malaria prevention methods compared to 65.8% of the younger SAC aged 9–12 years (**Table 16**).

Mosquito net ownership and use

Almost three-quarters (74.1%) of SAC who reported owning a mosquito net at home were aware of malaria prevention methods, while less than half (45.8%) of SAC without a mosquito net at home were aware of malaria prevention methods. Also, 75.8% of the SAC who slept under a mosquito net the night before the survey were aware of any malaria prevention method, compared to 63.6% of those who did not sleep under a mosquito net the night before the survey (**Table 16**).

Elevation

Three-quarters (75.6%) of the SAC residing in areas of altitude below 750m (asl) reported having knowledge of malaria prevention methods compared to those residing in areas above 750m (asl) (60.1%) (**Table 16**).

Malaria epidemiological strata

Knowledge of malaria prevention varied across malaria epidemiological strata, ranging from 57.1% in very low to 73.5% in moderate malaria epidemiological strata (**Table 16**).

Geographical zones

Across various geographical zones knowledge was high: 78.2%,73.7% and 70.2% in the Eastern, Southern and Western zones, respectively. Other zones recorded knowledge below (70.0%) (**Table 16**).

Regions

The highest proportion of SAC with knowledge of malaria prevention methods were recorded in Lindi (84.5%), Dar es Salaam (81.5%) and Katavi (80.6%). SAC in Kilimanjaro (48.1%) and Rukwa (46.8%) had the least knowledge of malaria prevention methods (**Table 16**).

Table 16: Knowledge on malaria prevention methods among SAC

BACKGROUND CHARACTERISTICS	AWARENESS OF MALARIA PREVENTION METHODS	NUMBER OF SAC INTERVIEWED	MALARIA PREVENTION METHODS							NUMBER OF SAC WITH AWARENESS OF MALARIA PREVENTION METHODS
			MOSQUITO NET	IRS	BODY TEMPERATURE	REPELLENTS	SPRAYING	ENVIRONMENTAL MODIFICATION	OTHERS	
Total	**68.7**	**14929**	**97.6**	**4.5**	**6.4**	**13**	**8.4**	**13**	**1**	**10260**
Malaria test results										
Negative	68.6	12999	97.4	4.4	6.8	13.5	9	13.4	1.1	*8918*
Positive	69.5	1930	98.6	5.4	4.2	9.5	4.2	10.8	0.4	*1342*
Gender										
Girls	68.1	7319	97.8	4.6	6.5	12.8	8.6	13.2	0.8	4984
Boys	69.3	7610	97.3	4.5	6.4	13.2	8.2	12.9	1.1	5276
Final age categories										
9–12	65.8	11488	97.5	4.3	6.6	12.9	8.5	12.2	1	7562
13–16	78.4	3441	97.8	5.3	5.9	13.3	8.1	15.3	0.9	2698
Do have a mosquito net at home?										
Yes	74.1	12095	97.9	4.7	6.6	13.5	8.4	13.1	1.1	8963
No	45.8	2834	94.9	3.5	5.6	9.4	8.3	12.2	0.5	1297
Did you sleep under a mosquito net last night?										
Yes	75.8	10445	98	4.8	6.9	13.8	8.7	13.4	1.1	7914
No	63.6	1650	97.5	3.6	3.9	11.3	6.1	11.3	1	1049
Distance of the school from the nearby health facility										
less than 5km	68.8	7393	97.5	5.3	7	11.9	9.1	12.9	1	5089
5km or more	68.6	7536	97.6	3.7	5.9	14.1	7.7	13.2	1	5171
Elevation										
Below 750m	75.6	4826	97.9	1.9	6	15.1	10.9	15.1	1.2	3650

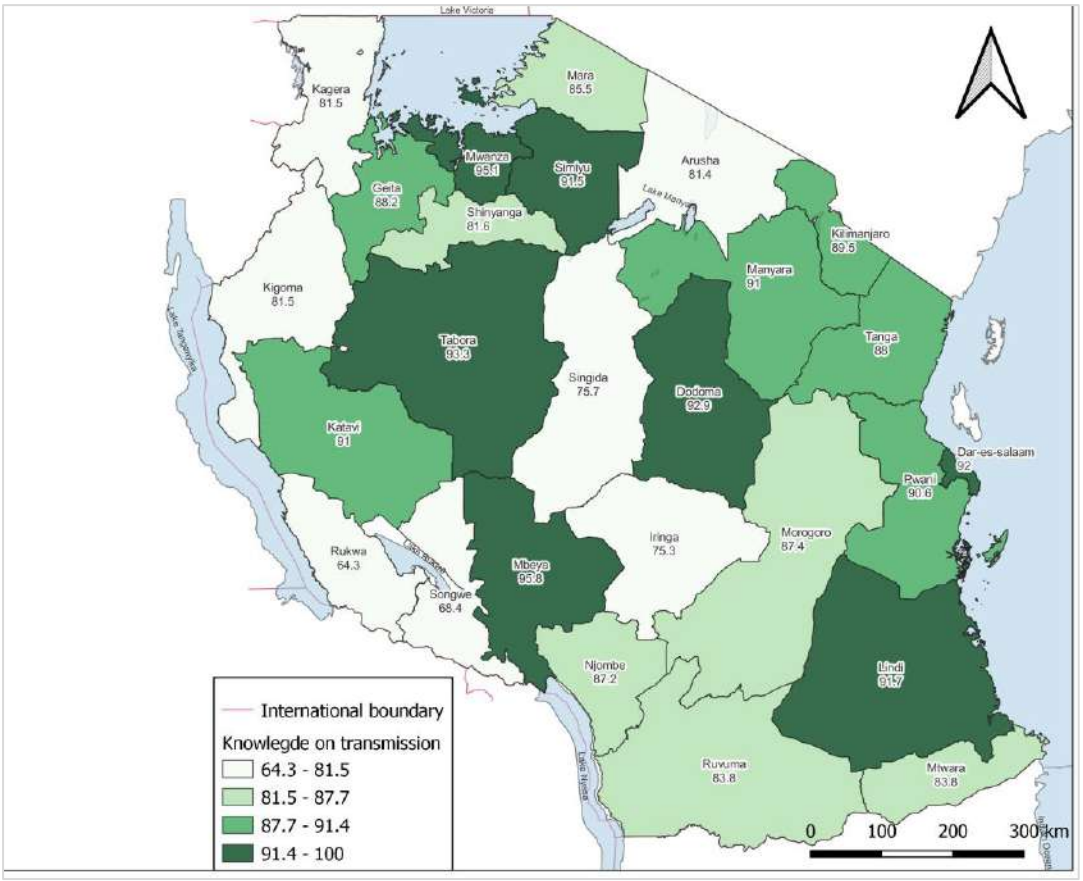
BACKGROUND CHARACTERISTICS	AWARENESS OF MALARIA PREVENTION METHODS	NUMBER OF SAC INTERVIEWED	MALARIA PREVENTION METHODS							NUMBER OF SAC WITH AWARENESS OF MALARIA PREVENTION METHODS
			MOSQUITO NET	IRS	BODY TEMPERATURE	REPELLENTS	SPRAYING	ENVIRONMENTAL MODIFICATION	OTHERS	
750–1250m	67.6	5458	97.3	5.9	5.8	11.2	5.6	9.4	0.7	3687
1250–1750m	63.4	3940	97.5	6.4	8.2	14.1	9.4	15.0	1.2	2499
Above 1750	60.1	705	97.6	4.2	4.7	4.2	5.4	14.6	0.5	424
Malaria epidemiological strata										
Very low	57.1	2500	96.6	6.0	11.4	15.5	11.7	22.8	0.9	1427
Low	72	3492	97.1	6.0	9.5	17.7	13.4	14.4	1	2514
Moderate	73.5	3360	97.7	1.4	3.8	12.6	6.4	11.9	0.7	2470
Very high	69	5577	98.1	5.0	4.3	9.2	5.2	9.2	1.1	3849
Geographical zone										
Eastern	78.2	2418	97.9	1.2	6.2	18.9	13.8	15.3	0.9	1891
Southern	73.7	855	97.3	3.5	4.9	10.0	5.2	13.2	3.2	630
Western	70.2	1471	98.8	4.5	4.6	8.7	3.1	6.8	0.7	1033
Southern Highlands	69.8	1208	97.5	3.4	6.5	7.6	10.7	17.9	0.9	843
Central	69.5	1886	96.4	7.7	12.6	17.3	9.3	13.3	1.1	1310
Lake	68.2	3666	98	5.8	3.0	10.6	4.6	9.0	0.9	2502
Southwest Highlands	63.5	1418	97.3	1.2	1.8	7.8	6.0	10.3	0.3	901
Northern	57.3	2007	96.4	7.5	13.2	17.1	13.4	21.8	0.8	1150
Region										
Lindi	84.5	348	99	5.4	4.1	7.1	5.8	9.9	0.7	294
Dar es Salaam	81.5	1233	98.1	0.7	6.8	25.5	20.3	18.7	1.7	1005
Katavi	80.6	288	97.8	3.0	0.9	4.7	3.9	6.9	0.4	232
Pwani	79	476	98.1	2.4	6.6	15.2	9.8	11.4	0.0	376
Dodoma	77.6	704	95.2	12.5	17	22.5	6.2	12.6	0.9	546

BACKGROUND CHARACTERISTICS	AWARENESS OF MALARIA PREVENTION METHODS	NUMBER OF SAC INTERVIEWED	MALARIA PREVENTION METHODS							NUMBER OF SAC WITH AWARENESS OF MALARIA PREVENTION METHODS
			MOSQUITO NET	IRS	BODY TEMPERATURE	REPELLENTS	SPRAYING	ENVIRONMENTAL MODIFICATION	OTHERS	
Mwanza	75.6	824	97.8	11.1	7.1	16.9	7.2	12.7	0.8	623
Shinyanga	75.2	452	98.5	0.3	2.6	18.2	1.8	4.4	0.3	340
Mbeya	74.6	417	98.7	1.3	1.9	9.0	9.0	14.8	0.0	311
Ruvuma	73	492	96.9	1.9	8.4	6.7	11.4	16.2	1.1	359
Mara	72.7	593	98.1	3.0	1.6	9.7	5.6	8.4	2.3	431
Morogoro	71.9	709	97.5	1.4	4.9	8.6	3.9	11.6	0.0	510
Tabora	71.1	795	99.1	5.0	6.9	12.4	3.7	8.0	0.5	565
Njombe	69.4	399	98.2	7.9	7.9	5.8	11.9	20.2	0.4	277
Kigoma	69.2	676	98.5	4.1	1.9	4.3	2.4	5.3	0.9	468
Tanga	68.3	669	97.2	7.4	11.2	16.4	14.2	16.0	1.1	457
Simiyu	66.7	495	98.8	0.3	0.9	7.6	3.0	6.1	1.5	330
Geita	66.3	537	96.6	10.1	1.4	4.2	2.2	10.7	0.0	356
Mtwara	66.3	507	95.8	1.8	5.7	12.5	4.8	16.1	5.4	336
Singida	66	471	98.1	4.2	2.3	15.8	2.3	6.4	2.9	311
Iringa	65.3	317	97.6	0.0	1.4	11.6	7.7	17.9	1.4	207
Manyara	63.7	711	96.7	4.4	14.3	11.9	17.9	18.8	0.2	453
Kagera	55.2	765	98.3	5.9	1.7	4.0	5.2	8.5	0.2	422
Arusha	55	720	94.4	13.1	18.9	19.4	13.4	27.8	0.8	396
Songwe	54.6	313	92.4	0.0	4.7	11.7	8.8	11.7	0.0	171
Kilimanjaro	48.1	618	98	0.0	8.8	15.2	12.1	22.9	0.3	297
Rukwa	46.8	400	98.9	0.0	0.0	5.9	1.1	5.9	1.1	187

3.12 Knowledge of malaria transmission

Of the 14,984 SAC interviewed to determine their knowledge of malaria transmission, a large majority (91.3%) reported that malaria is transmitted by mosquitoes; only 8.7% of the SAC were not aware of how malaria is transmitted (**Table 17** and **Figure 22).**

Figure 22. Knowledge of malaria transmission amongst SAC



Age and gender

A majority of both boys (91.4%) and girls (91.1%) were aware of how malaria is transmitted. Knowledge varied across age groups; 95.0% of older SAC aged 13–16 years mentioned mosquitoes as a means of malaria transmission compared to 90.1% of SAC aged 9–12 years **(Table 17**).

Elevation

Knowledge of malaria transmission increased with decreasing altitude, where the largest proportion of SAC with such knowledge (93.9%) hailed from areas below 750m (asl) while the lower proportion of SAC (81.4%) hailed from areas above 1750m (asl) **(Table 17**).

Malaria epidemiological strata

Knowledge of malaria transmission was almost fairly distributed across all epidemiological strata **(Table 17**).

Zones

In 71.4% of the seven geographic zones (5/7) over 90% of SAC reported that mosquitoes are a means of malaria transmission. In the remaining two zones, more than 80% of SAC reported such knowledge **(Table 17).**

Regions

Generally, in 65.4% (17/26) of the regions, over 90% of the SAC mentioned mosquitoes as a means of malaria transmission. Songwe reported the lowest proportion of SAC with such knowledge, at 76.2% **(Table 17**).

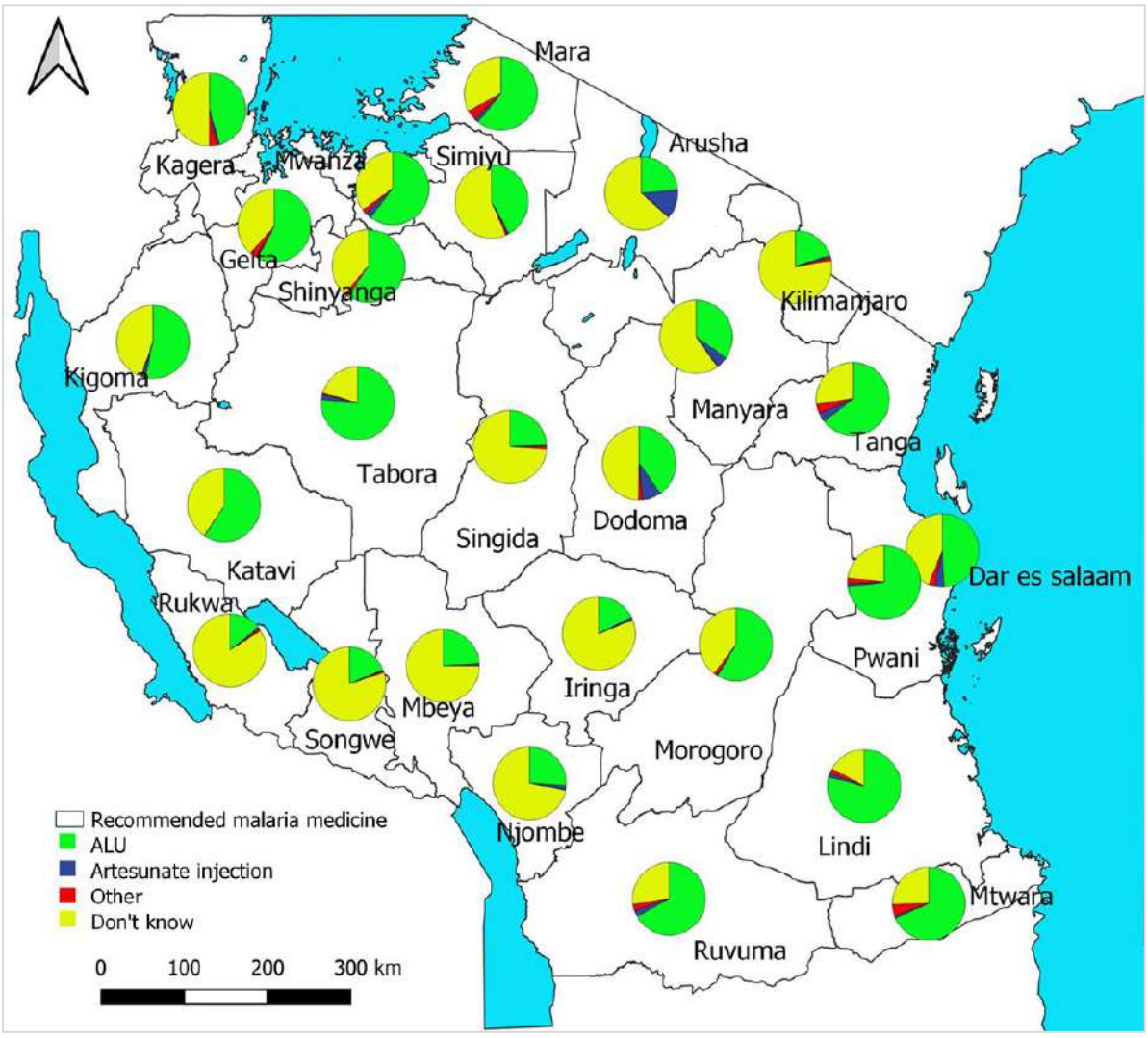
Table 17: Knowledge of malaria transmission

BACKGROUND CHARACTERISTICS	MALARIA TRANSMISSION		TOTAL
	MOSQUITO	OTHERS	
Total	**91.3**	**8.7**	**14984**
Gender			
Girls	91.1	8.9	7353
Boys	91.4	8.6	7631
Age			
9–12	90.1	9.9	11530
13–16	95.0	5.0	3454
Do you have a mosquito net at home?			
Yes	92.3	7.7	12139
No	86.7	13.3	2845
Did you sleep under a mosquito net last night?			
Yes	93.2	6.8	10484
No	86.6	13.4	1655
Distance of the school from the nearby health facility			
less than 5km	91.4	8.6	7424
5km or more	91.1	8.9	7560
Elevation			
Below 750m	93.9	6.1	4842
750–1250m	91.0	9.0	5476
1250–1750m	90.2	9.8	3957
Above 1750	81.4	18.6	709
Malaria epidemiological strata			
Very low	89.0	11.0	2509
Low	90.6	9.4	3511
Moderate	92.6	7.4	3365
Very high	92.0	8.0	5599
Geographical zones			
Central	91.5	8.5	1891
Eastern	95.1	4.9	2428
Lake	91.2	8.8	3681
Northern	89.2	10.8	2015
Southern Highlands	89.3	10.7	1211
Southwest Highlands	87.4	12.6	1425
Southern	92.5	7.5	858
Western	92.3	7.7	1475

3.13 Knowledge of recommended antimalarial medicine amongst SAC

A total of 14,984 SAC were interviewed to determine their awareness of the recommended antimalarial medicine for treatment. Artemether-Lumefantrine (ALu) was mentioned by 56.0% of the SAC, while 42.2% of them were not aware of any antimalarial medication **(Figure 23)**.

Figure 23. SAC knowledge of recommended malaria medicines



Age and gender

More than half of the SAC interviewed, 55.1% of boys and 56.9% of girls, reported ALu as the recommended antimalarial medication. Awareness also varied across age groups, where 64.3% of older SAC (13–16 years) were slightly more aware than younger SAC (9–12 years) (53.5%).

Elevation

Awareness of the recommended antimalarial medication increased with decreasing altitude., The highest awareness rate was 70.2% among SAC residing below 750m (asl) and the lowest (22.4%) amongst those residing above 1750m (asl) **(Figure 24).**

Figure 24. Knowledge of the recommended antimalarial medicine

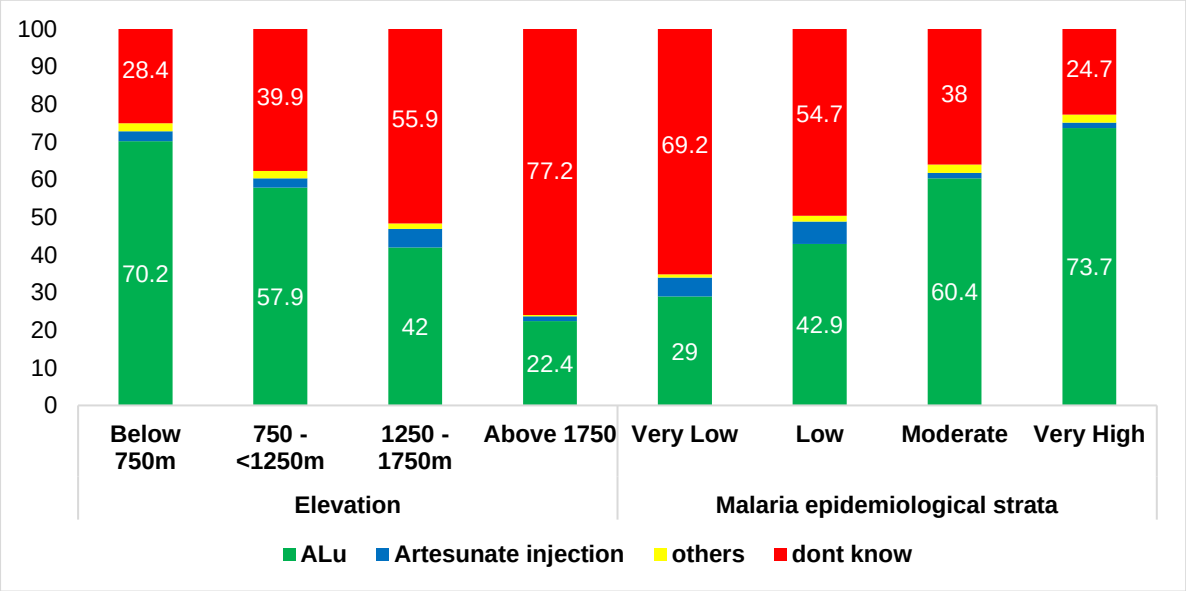
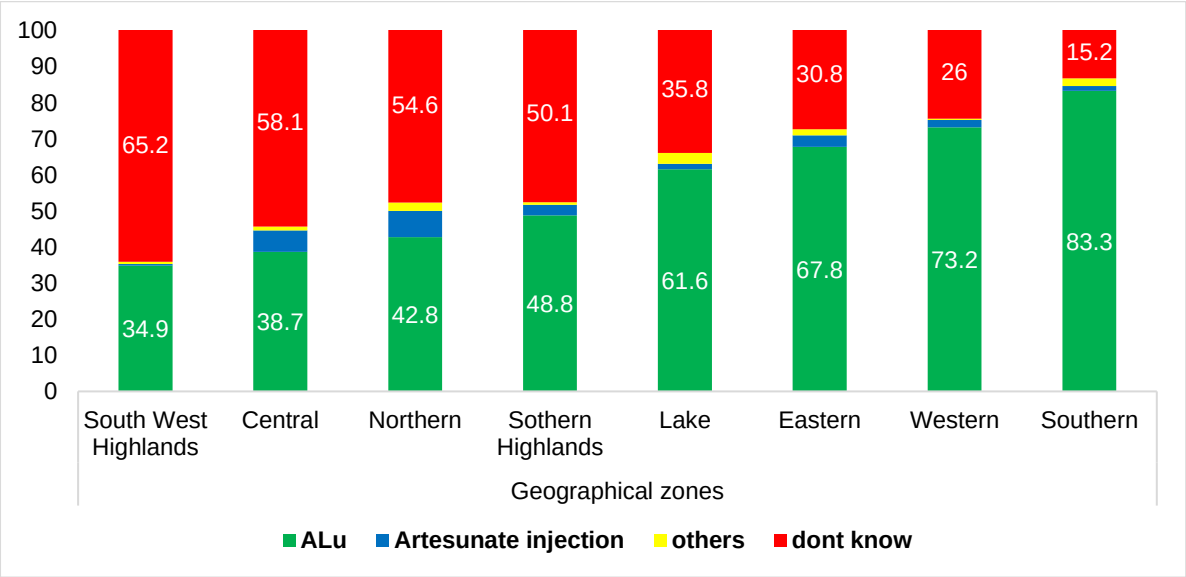


Figure 25. Knowledge oF the recommended antimalarial medicine by zones



Malaria epidemiological strata

A higher proportion of SAC (73.7%) residing in high malaria epidemiological strata were aware of the recommended antimalarial medicine; the least awareness (29.0%) was recorded in very low malaria epidemiological strata **(Figure 24**).

Zones

A higher proportion (83.3%) of SAC in the Southern zone were aware of the recommended antimalarial medicine compared to SAC in Southwest Highlands (34.9%) **(Figure 25)**.

Region

The highest proportion (87.4%) of SAC with awareness of the recommended antimalarial medicine was recorded in Lindi, whilst the least was in Rukwa, at 19.4% **(Figure 25)**.

3.13 Nutritional indices

Anaemia prevalence among SAC

Determination of anaemia was conducted in one-third (22,296) of the total SAC in the survey. Results indicate that the overall anaemia prevalence was 32%; less than 1% (0.7%) of the SAC had a severe form of anaemia, 14.2% had mild anaemia and 17.0% had moderate anaemia. **Table 18** shows the results by malaria infection, age, gender and malaria epidemiological strata.

Age and gender

Figure 26 and **Figure 27** and **Table 18** indicate anaemia prevalence across different age groups and genders (girls and boys), respectively. Results indicate that SAC aged 15 to 16 years were more anaemic (54.8%) than other age groups. However, prevalence of severe anaemia within and between the age groups and gender was below 1%. Anaemia rates were similar among boys and girls (32.5% and 31.4%, respectively). Furthermore, girls aged 15–16 years recorded a higher percentage of moderate anaemia (17.6%) and severe anaemia (0.9%) compared to boys of the same age category (12.9% and 0.3%). Contrary to that, mild anaemia was higher amongst boys (52%) than girls (20.6%).

Anaemia and malaria infection

Among SAC who were tested for haemoglobin concentration, half (51.3%) were found to have co-existence of malaria and anaemia. Furthermore, one-third (31%) of children with malaria had moderate anaemia followed by 19% with mild anaemia and only 1.4% with severe anaemia.

Figure 26. Prevalence of anaemia amongst girls by age

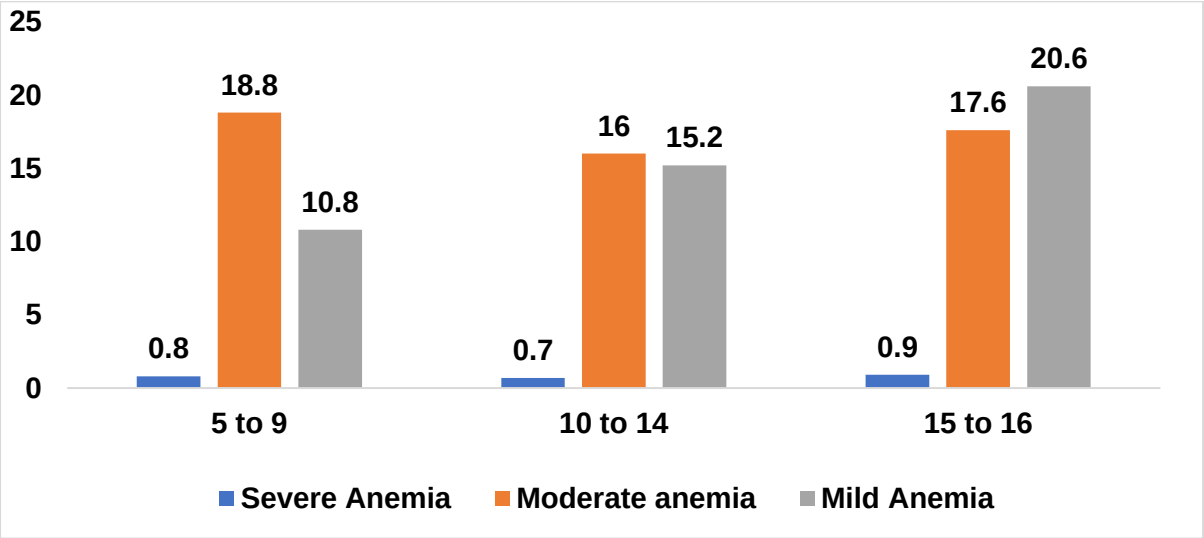
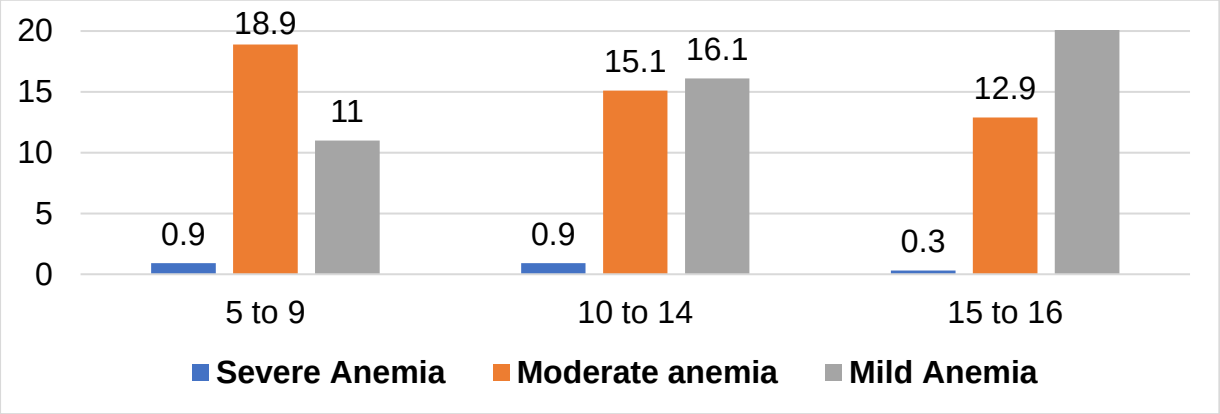


Figure 27. Prevalence of anaemia amongst boys by age



Elevation and malaria epidemiological strata

The results show an increase in any form of anaemia with decreasing altitude, where a high proportion of SAC (38.3%) with any form of anaemia were found in lowlands (≤ 750m asl) compared to 18.0% of SAC in high altitude or mountainous areas (≥ 1750m asl). The burden of any form of anaemia was found to be higher (39.6%) among SAC living in high malaria epidemiological strata compared to 16% of those living in very low malaria epidemiological strata. Similarly, a high prevalence (22.3%) of moderate anaemia was also found in high malaria epidemiological strata and severe anaemia (1.1%) in high malaria strata; the malaria rate was only 0.2% in very low malaria epidemiological strata.

Geographical zones and regions

High prevalence of anaemia was observed in the Southern zone (42%) mainly in Mtwara (43.7%) and Lindi (39.4%) regions, followed by the Eastern zone (40.2%) mainly in Pwani (56.5%), Tanga (40.0%) and Dar es Salaam (40.2%). In addition to that, Western zone reported 37.3%, with a higher prevalence reported in Tabora (45%). Other regions with high anaemia prevalence were Simiyu (45.4%), Shinyanga (44.6%) and Katavi (40.7%) (**Table 18** and **Figure 28**).

Councils

Figure 28. Anaemia prevalence by region

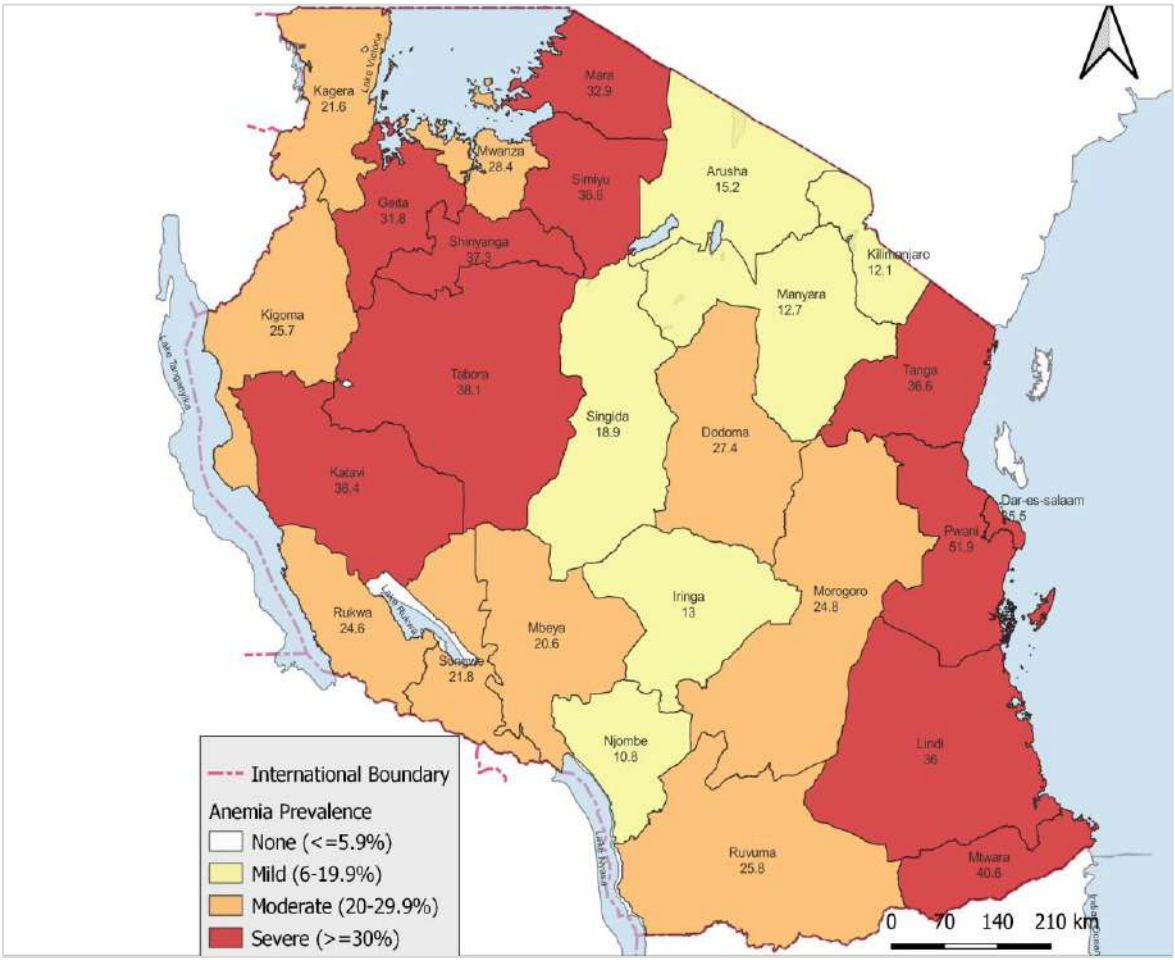


Figure 29. Anaemia prevalence by council

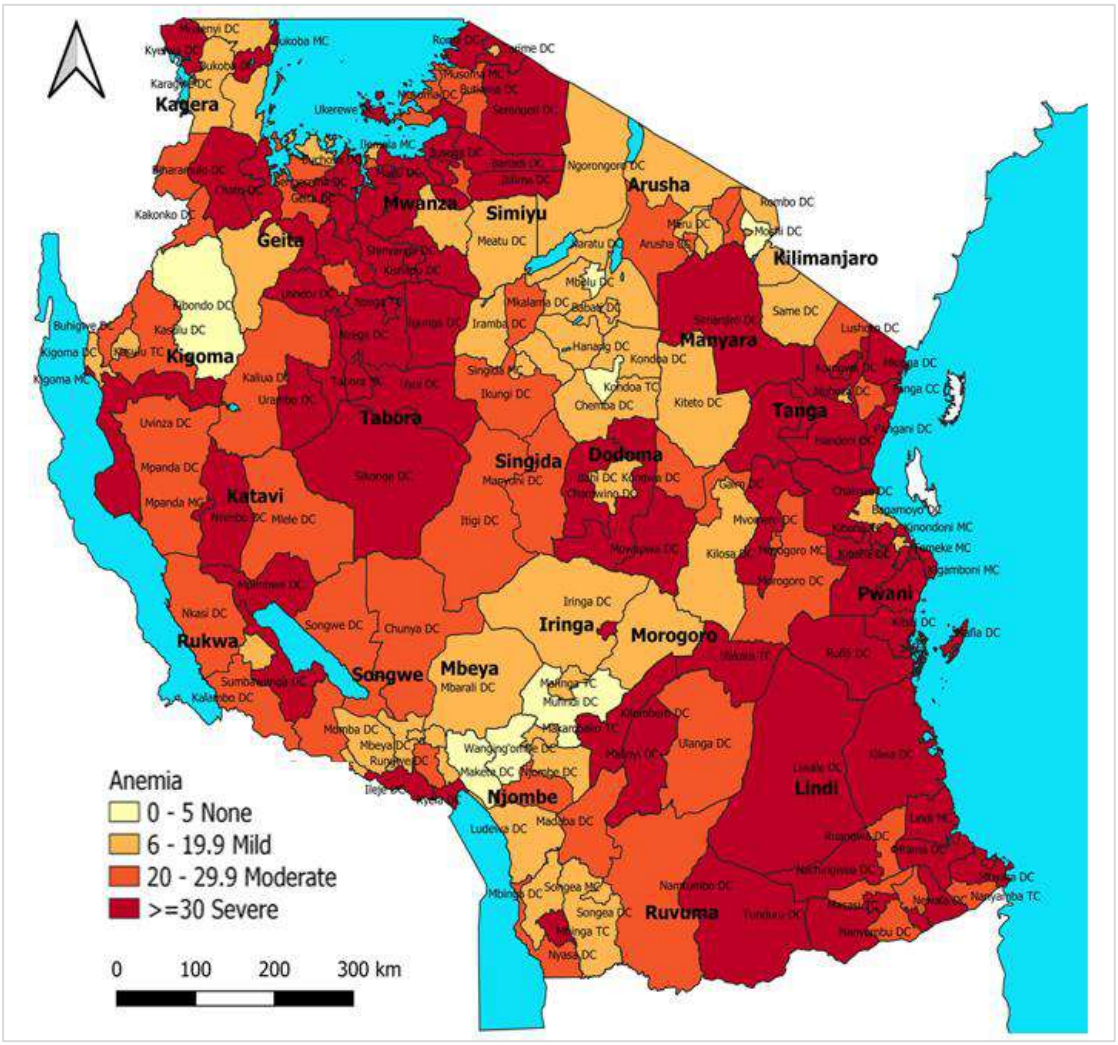


Table 18: Prevalence of anemia amongst SAC

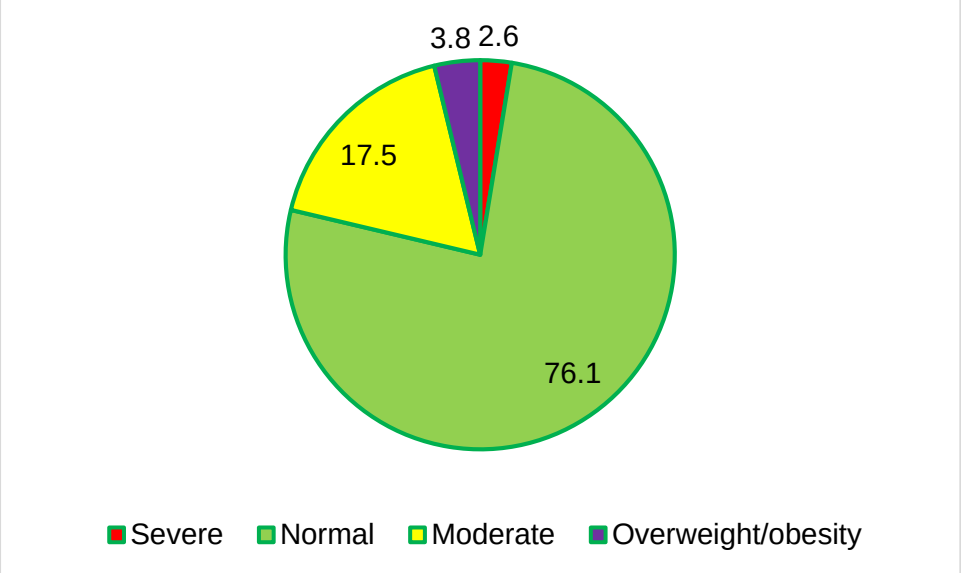
BACKGROUND CHARACTERISTICS	ANY ANAEMIA	SEVERE	MODERATE	MILD	NORMAL	TOTAL NUMBER OF PUPILS
Age (In Years)						
5–9	30.6	0.7	19	10.9	69.4	9,913
10–14	31.9	0.6	15.5	15.7	68.1	11,762
15–16	54.8	0.3	14.9	39.6	45.2	591
Gender						
Girls	31.4	0.6	17.5	13.3	68.6	11,148
Boys	32.5	0.7	16.6	15.1	67.5	11,148
Malaria epidemiological strata						
Very low	16	0.2	7.4	8.3	84	3,768
Low	29.3	0.5	14.2	14.6	70.7	5,390
Moderate	34.4	0.4	18.9	15.1	65.6	5,063
Very high	39.6	1.1	22.3	16.1	60.4	8,075
Elevation						
Below 750m	38.3	0.6	20.9	16.7	61.7	7,259
750–1250m	34	0.7	18.5	14.8	66	8,002
1250–1750m	23.9	0.4	12.2	11.4	76.1	5,922
Above 1750	18	2	7.1	8.9	82	1,113
Malaria infections						
Negative	29.3	0.6	15.2	13.6	70.7	19,670
Positive	51.3	1.4	31	19	48.7	2,626
Geographical zone						
Central	24.2	0.7	13.1	10.4	75.8	2,667
Eastern	40.2	0.5	20.7	19	59.8	3,663
Lake	36.1	1.1	19.6	15.4	63.9	5,329
Northern	23.9	0.2	13.1	10.7	76.1	3,055
Southern Highlands	19.9	0.1	9.9	10.0	80.1	1,957
Southwest Highlands	28.3	0.5	14.1	13.6	71.7	2,257
Southern	42.0	1.4	24.1	16.6	58	1,292
Western	37.3	0.7	20.6	16	62.7	2,076

3.15 SAC nutrition status by mid upper arm circumference (MUAC)

A total of 62,164 SAC were assessed on nutrition using the MUAC method. Overall, 20.2% of SAC had acute malnutrition, 2.6% had severe acute malnutrition (SAM), 17.6% had moderate acute malnutrition (MAM) and 3.8% were overweight or obese (**Table 19).**

Prevalence of acute malnutrition was higher in the Central zone (27.2%) than in other zones. Eastern zone had the lowest prevalence of acute malnutrition (14.3%). However, the Northern zone (24.1%) had a higher proportion of SAC with MAM than other zones. Regions with a higher proportion of SAC with MAM included Manyara (41.9%), Simiyu (26.6%), Kigoma (25.5%), Kilimanjaro (25.4%), Singida (25.1%) and Geita (25.1%). Furthermore, Lindi had the highest proportion (9.7%) of SAC who were overweight or obese. Other regions that reported a high proportion of SAC who were overweight or obese included Morogoro (9.2%), Pwani (7.7%), Dar es Salaam (5.8%) and Tabora (5.7%.). The lowest prevalence of overweight/obesity was recorded in Manyara (0.7%), Njombe (0.8%) and Kilimanjaro (0.9%) regions **Table 19** and **Figure 30**.

Figure 30: Nutrition status amongst SAC



Thinness

Overall, 76% of all SAC had normal nutrition status. The prevalence of both SAM and MAM increased with an increase in age, where the higher prevalence (48.4%) of acute malnutrition was observed among SAC aged 15–16 years. However, MAM was slightly higher among male SAC (22.4%) compared to female SAC (17.9%).

Based on geographical zones, the Central zone had the highest prevalence of acute malnutrition (27%) and the lowest (14.3%) was recorded in Eastern zone.

Overweight

The findings show that 3.8% of all SAC were overweight or obese. Prevalence of overweight was slightly higher among girls (4.3%) than boys (3.3%). Based on age categories, overweight and obesity were more prevalent among SAC aged 10–14 years. Furthermore, overweight

and obesity were more prevalent in the Eastern zone (6.3 %) and lowest (1.9%) in Southwest Highlands (**Table 19**).

Nutrition status and anaemia

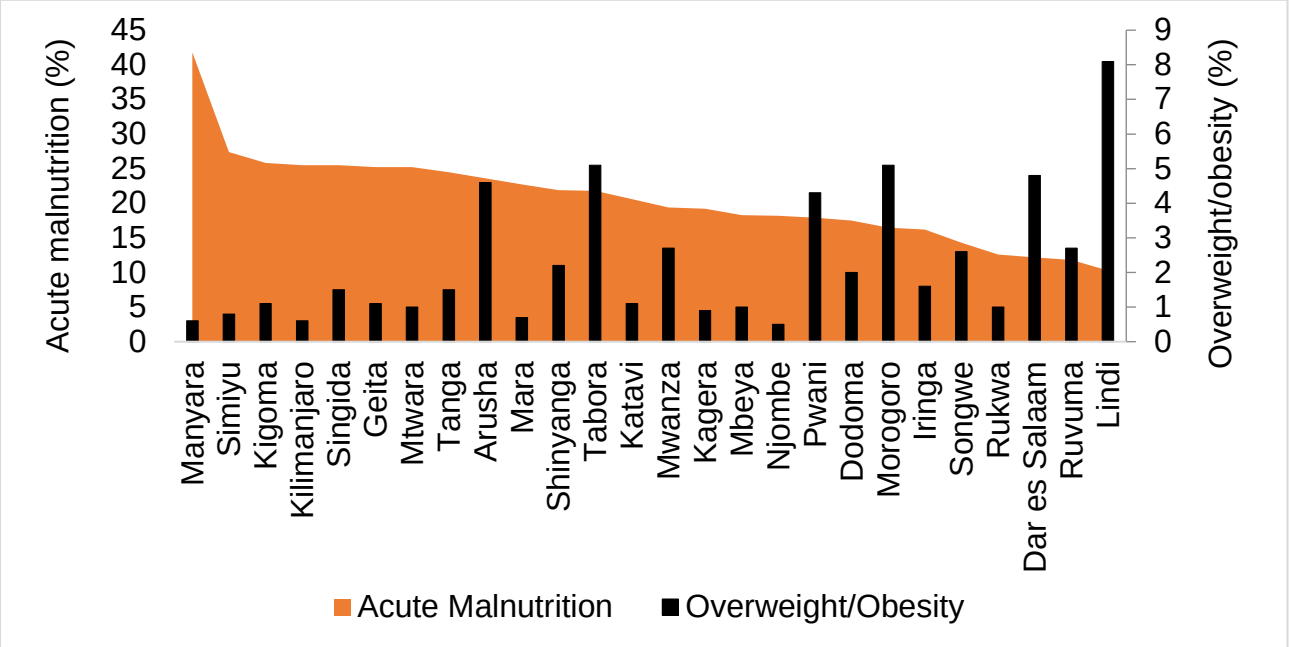
About 20% of SAC with acute malnutrition had any form of anaemia; 2.5% had SAM, 17.2% MAM and 4.3% were overweight or obese. Similarly, about 20.1% of all SAC who had acute malnutrition had normal haemoglobin levels. Among those who were acutely malnourished and anaemic, 32.9% had severe anaemia (**Table 19**).

Table 19: Prevalence of acute malnutrition and overweight/obesity

BACKGROUND CHARACTERISTICS	ACUTE MALNUTRITION	SEVERE	MODERATE	NORMAL	OVERWEIGHT/OBESITY	TOTAL NUMBER OF SAC[X]
Total	**20.2**	**2.6**	**17.6**	**76.1**	**3.8**	**62,164**
Gender						
Girls	17.9	2.4	15.5	77.8	4.3	31,185
Boys	22.4	2.7	19.7	74.3	3.3	30,979
Age (In years)						
5 – 9	3.4	1.4	2	93.6	3	27,893
10 – 14	33.1	3.2	29.9	62.4	4.5	32,766
15 – 16	48.4	10.1	38.3	47.6	3.9	1,505
Anaemia status						
Any anaemia	19.7	2.5	17.2	76	4.3	6,840
Severe	32.8	6.1	26.7	63.4	3.8	131
Moderate	17.9	2.2	15.7	77.1	5	3,656
Mild	21.3	2.8	18.5	75.2	3.6	3,053
Normal	20.1	2.2	17.9	76.1	3.8	14,694
Zone						
Central	27	2.7	24.3	70.7	2.3	6,878
Eastern	14.3	1.4	12.9	79.4	6.3	10,498
Lake	21.5	2.6	18.9	74.3	4.2	15,276
Northern	24.1	4.9	19.2	73.2	2.7	8,536
Southern Highlands	14.9	1.3	13.5	83.3	1.8	5,599
Southwest Highlands	16.4	2.1	14.3	81.6	1.9	6,403
Southern	18.7	3	15.7	75.3	6	3,445
Western	23.6	2.2	21.4	72.1	4.3	5,529

(**x**)Due to marked outliers; results from six councils, namely: Simanjiro and Kiteto (Manyara), Nzega DC (Tabora), Mwanga (Kilimanjaro), Magu (Mwanza) and Mtwara DC (Mtwara), are excluded with findings of 2,067 SAC.

Figure 31. Prevalence of malnutrition by regions



Dietary quality amongst SAC

In this survey, exposure and intake of healthy and unhealthy foods items were assessed, among 21,995 SACs. Findings revealed that mostly healthy food groups were consumed (more than four times per week) by at least one-fifth of SAC. These foods include liquid vegetable oils (35.2%), legumes (30.9%) and white roots and tubers (20.3%). Other reported healthy food groups were dark leafy green vegetable (19.1%), other vegetables (17.5%), whole fruits (17.5%) and (14.5%) fish. Despite the low frequency of fish consumption reported in this study, slightly higher consumption frequencies were recorded in regions around lakes, the ocean and rivers such as Tanga (29.5%), Mara (28.0%), Pwani (24.7%), Dar es salaam (19.5%), Rukwa (18.5%) and Mwanza (18.3%).

The least consumed healthy food groups were low fat diary (2.2%), poultry (4.3%) and eggs (10.8%). Consumption of unhealthy foods was also reported in this study, where more than 10% of all SAC reported consuming deserts and ice cream (10.6%) more than four times per week, followed by fried foods bought outside the home (8.4%) and red meat (5.3%). SAC from Tanga (22.2%), Dar es Salaam (20.1%), Mtwara (18.2%), Katavi (16.9%) and Lindi (15.5%) consumed sweetened foods more than four times per week. At least 6.2% of all SAC reported consuming sugar sweetened beverages two to three times a week.

The status of the School Feeding Programme in Tanzania

3.17 Availability, components and coordination of SFP

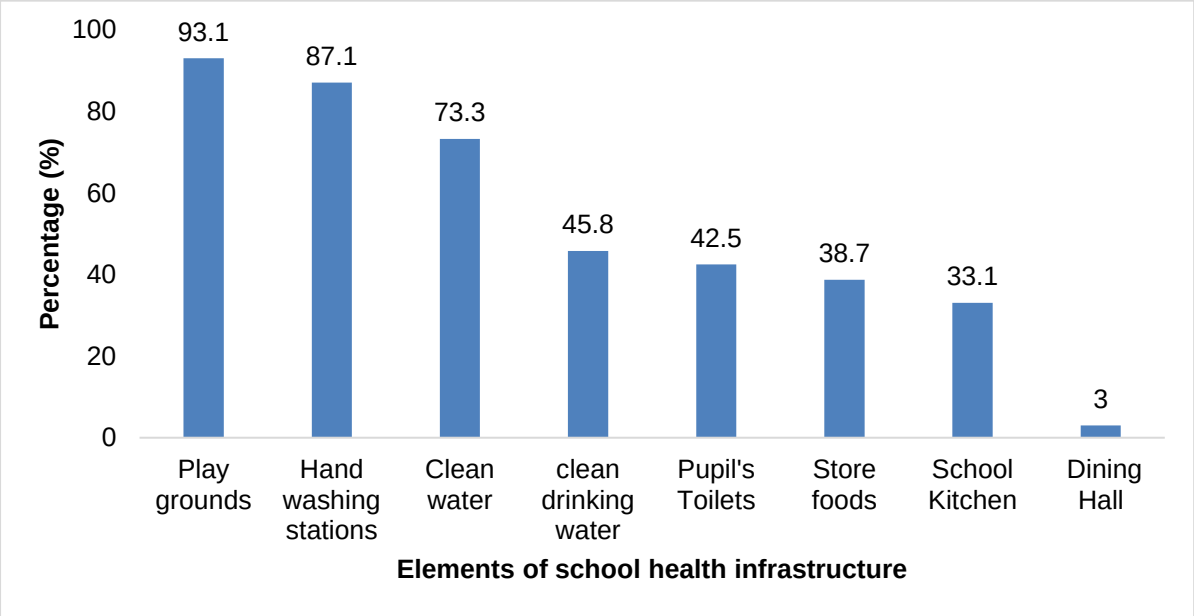
A total 650 public schools were visited during survey to obtain the status of the SFP. The overall findings from this survey revealed that half (53.4%) of the public primary schools in mainland Tanzania did not implement an SFP.

Only three out of eight (37.5%) geographical zones had high proportions of schools that reported implementing an SFP: Northen zone (Kilimanjaro, Arusha and Tanga) 79.3%,

Southern Highlands zone (Njombe, Iringa, Ruvuma) 73.7% and Southern zone (Mtwara and Lindi) 58.3%. The two zones with the lowest proportion of schools with an SFP were Southwest Highlands (Mbeya, Songwe, Rukwa and Katavi), 33.3%, and Lake (Mwanza, Kagera, Mara, Geita, Simiyu and Shinyanga), 33.8%.

Only 6 regions out of 26 (23.1%) had a high proportion of schools that reported implementing an SFP: Njombe (94.1%), Kilimanjaro (93.3%), Arusha (81.3%), Iringa (75%), Manyara (69%) and Mtwara (68.2%). The regions with low proportions of schools implementing SFPs are Simiyu (10.5%, Rukwa (17.6%), Dodoma (17.2%), Kigoma (17.9%), Shinyanga (21.1%) and Katavi (25%). Furthermore, at the council level, the findings indicated that about one-third of the councils (58 councils out of 184) do implement SFP.

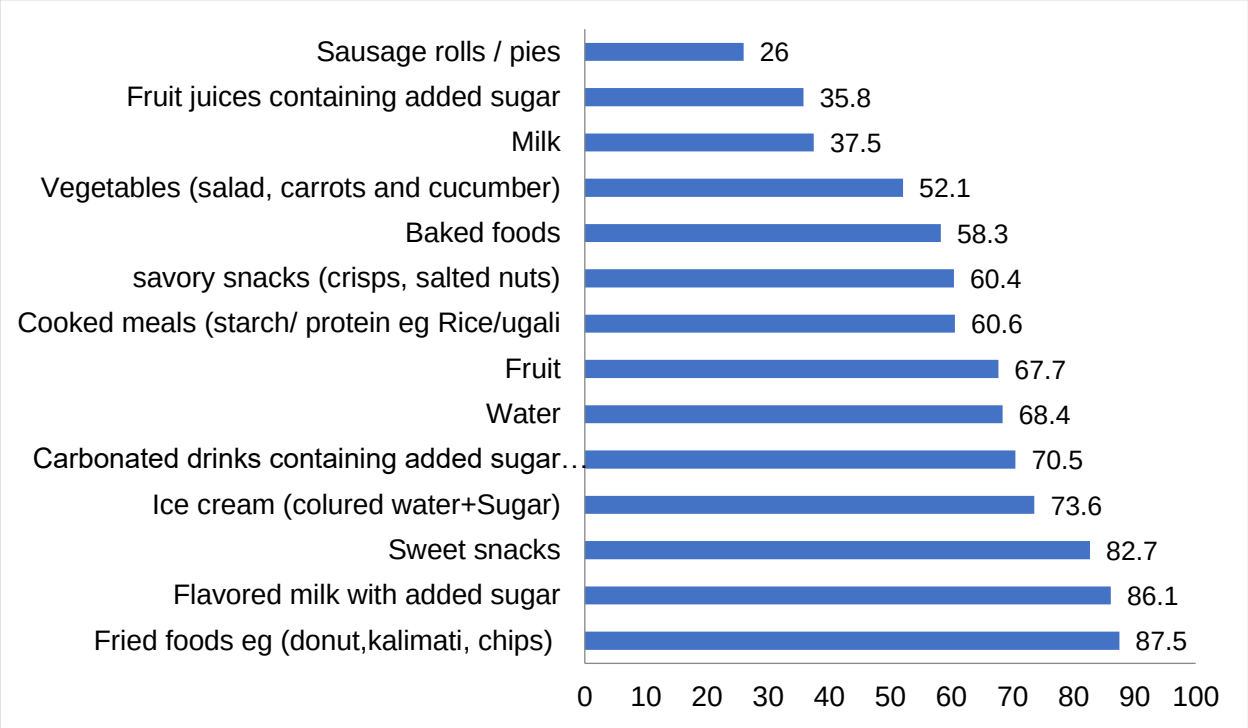
Figure 32. Availability of elements of SFP infrastructure



School environment

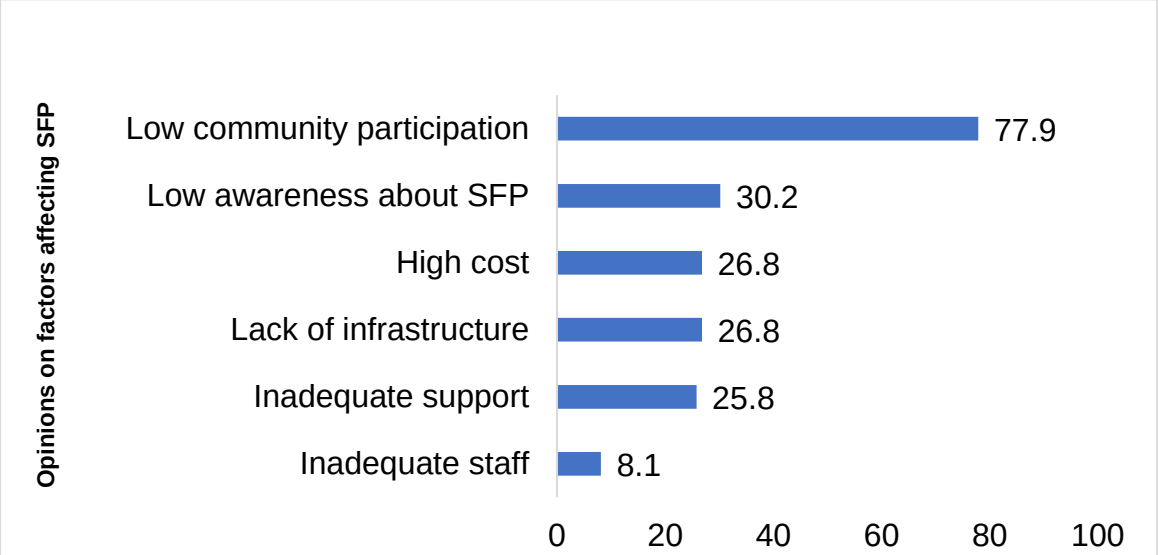
The results show that 44% of the surveyed schools were surrounded by food vendors. Fried food such as doughnuts and chips (87.5%), sweet snacks (82%) and carbonated drinks containing added sugar (soda) (70.5%) are available from these vendors. Moreover, vegetables (salad, carrots and cucumber) were available in at least half (52.1%) of the surveyed schools while fruit 67.7% and water 68.4% were available at more than half of the surveyed schools (**Figure 33**).

Figure 33. Types of food available from different food vendors around school



This survey asked the respondents (schools with SFP: *N*=278) to provide their opinion concerning the implementation of an SFP in public primary schools in mainland Tanzania. The findings revealed that more than three-quarters (77.9%) of respondents mentioned low community participation as the main challenge in implementing SFP, 26.8% noted infrastructure high costs and 25.8% said inadequate support from the government or private sector. Only 8% mentioned inadequate staff **(Figure 34**).

Figure 34. Factors affecting implementation of SFP in mainland Tanzania

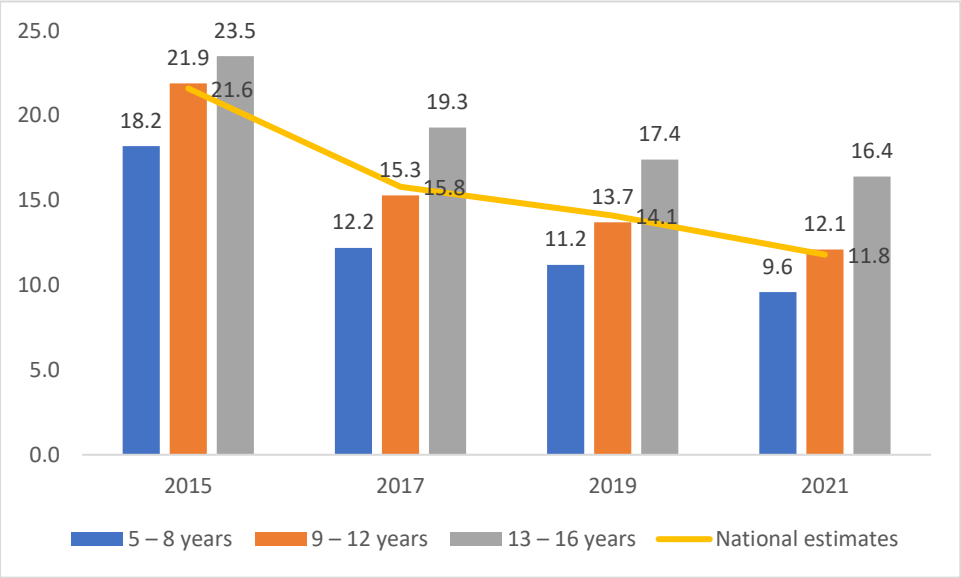


Chapter 4: Discussion

4.1 Malaria prevalence

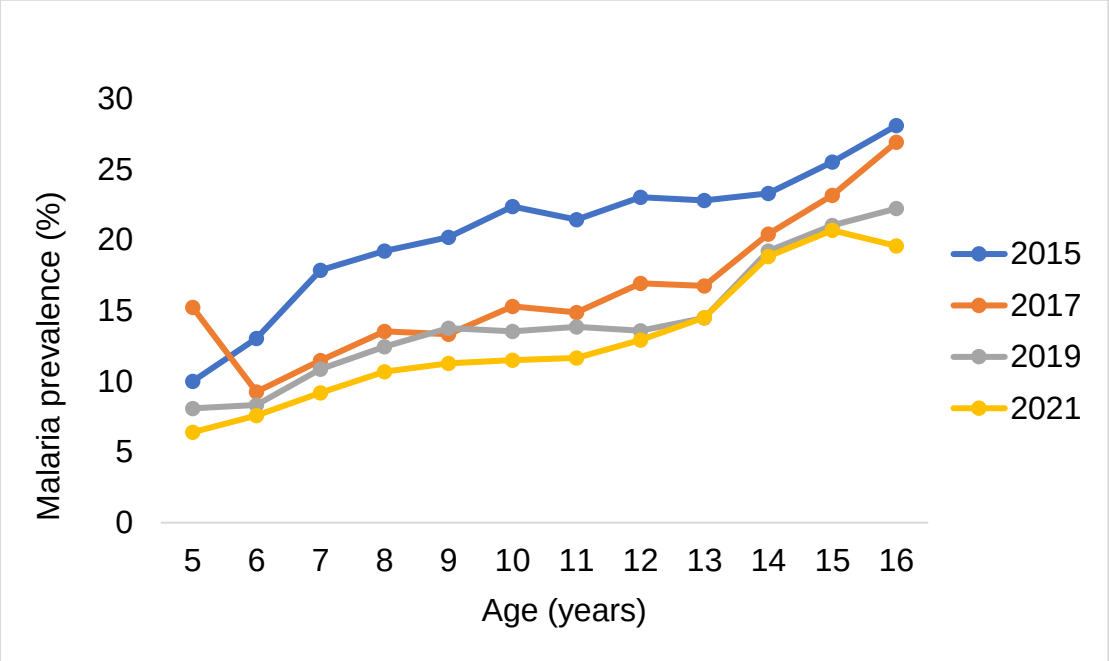
The SMNS cross-sectional survey recorded an overall national malaria prevalence of 11.8% amongst SAC aged 5–16 years with marked heterogeneity across background characteristics, malaria epidemiological strata, regions, geographical zones and councils. Compared to previous SMNS surveys, there is a notable decline in malaria prevalence among SAC: from 21.6% in 2015 to 11.8% in 2021 (**Figure 35**) (6–9). Results from the previous SMNS's conducted in 2015, 2017 and 2019 showed similar patterns in consistency of heterogeneity across the mentioned parameter. Higher malaria infection was recorded in Lake, Southern, and Western zones and amongst children aged 13–16 years (**Figure 35**). Malaria prevalence decreased the higher the altitude asl. However, in this SMNS, we confirmed a trend first seen in the 2019 SMNS. Wherein elevations between 750m–1250m asl had a higher prevalence (15.3%) compared to elevations below 750m asl (12.4%) (6–9). This could be attributed to the majority of schools surveyed being in the Dar es Salaam region, which is at a lower elevation and has a low malaria prevalence. However, more investigation should be done to further establish contributing factors.

Figure 35: Malaria prevalence trends among SAC (2015–2021)



We also observed variations in malaria prevalence across age groups, whether a child slept under the mosquito net and body temperature. Previous SMNS reports found that malaria increases with age (**Figure 36**), i.e. malaria prevalence was higher among SAC in the higher age group (13–16 years) compared to lowest one (5–8 years). This trend was similar in both the 2019 and 2021 SMNS (6–9) and may show an ongoing trend of malaria transmission burden amongst children and adolescent, possibly due to the fact that young children are more likely to be under parent or guardian care, i.e. using a bed net regularly, while older children may not have as much parent supervision and do not use bed nets frequently (47,48). A cross-sectional study conducted in Malawi revealed that SAC are "reservoirs" for malaria infection compared with younger children in all transmission settings and that they are less likely to be exposed to malaria control interventions (25).

Figure 36. Malaria prevalence by age and survey rounds



In the 2021 SMNS survey, boys were recorded to have higher malaria prevalence than girls, showing consistency with findings from previous SMNS surveys. Similar results were observed by Ea, E et al, during a study of SAC that was conducted in the southern and western parts of Nigeria where age and gender were reported to contribute to malaria infection (49). "Older children may serve as transmission reservoirs because acquired antimalarial immunity leads to persistent asymptomatic infections that are less likely to be treated with antimalarial drugs than acute febrile illnesses that present in young children" (25). Additionally, same study found that boys had a higher malaria prevalence compared to girls (25).

Overall, 80% of the SAC surveyed in Mainland Tanzania with malaria were asymptomatic, which plays an important role in leading to SAC serving as malaria "pools" in communities. We also observed high prevalence of malaria among SAC who reported not sleeping under a mosquito net the night before the survey. Although we cannot adequate infer conclusions based on 1-day data, this may mean that these children had a higher tendency to not use mosquito net on other days. Generally, in places with high malaria prevalence, also had high mosquito-net ownership, high exposure to malaria preventive messages and high knowledge/awareness of preventive methods. This calls a need for innovative, additional interventions that focus on SAC to improve malaria control in communities.

As most malaria infections do not present with fever as the main sign of infection in older children and adults, "malaria infections…may be missed in surveillance strategies that rely on microscopy or antigen detection, and can persist between seasons and perpetuate transmission". (25) In the four consecutive SMPS/SMNS surveys conducted in Tanzania, malaria prevalence has progressively declined among SAC **(Figure 36**). A 26.9% decline was observed from 2015 (21.6%) to 2017 (15.8%), 10.8% decline between 2017 (15.8%) and 2019 (14.1%) and 16.3% decline between 2019 (14.1%) and 2021 (11.8%). Overall, during the 6-year period (2015 through 2021), malaria infection declined by 45.4% (6–9). This reduction can be attributed to increased community access to different malaria control measures

deployed by the MoH through the NMCP, including effective communication promoting the prevention and control of malaria (16).

4.2 Household perception of health problems

Various health problems have been reported as major health problems in developing countries, including in Tanzania, such as HIV and AIDS, cancer, malaria and tuberculosis. Disease burden is perceived differently depending on a person's level of education and respective malaria epidemiological strata. For example, the SMNS survey found that the perception of malaria as a major health problem differed among respondents based on their education levels. In general, respondents with more education (e.g. secondary or higher education) were more aware of malaria and preventive measures. In addition, most of the respondents residing in areas with high malaria mentioned malaria as the major health problem, which might be because they are more likely to experience frequent malaria episodes.

4.3 Household knowledge on malaria signs and symptoms

According to the 2021 SMNS survey, fever was the most reported malaria symptom. This is probably because a fever is the most notable and common malaria symptom and people tend to seek medical attention earlier when presenting with a fever, i.e. before malaria advances to show other symptoms such as vomiting, headache and diarrhoea. It is noteworthy that in the 2021 SMNS survey, household respondents with secondary or higher education reported knowing more malaria symptoms of malaria, which might be due to high exposure or access to frequent malaria messages (4,5). Across epidemiological strata, people residing in high strata areas, and their respective geographical zones, are more likely to be exposed to malaria; hence, more likely to know malaria symptoms and signs.

4.4 Mosquito net ownership and use

Mosquito nets are an important tool for malaria prevention and control in developing countries like Tanzania. They are crucial in the country's malaria control efforts and have shown to have effective benefits in protecting vulnerable groups, particularly young children and pregnant mothers (50). The national goal is to achieve 85% population coverage with mosquito nets in all transmission settings and at all control phases (11).

The 2021 SMNS survey found a 12% decrease of mosquito net ownership, from 89.3% in the 2019 survey to 77.7% in 2021 (9). This decline may be attributed to general decay of mosquito nets due to prolonged use and lack of upkeep strategies. In addition, the decrease could also be attributed to interruption of the malaria control interventions and decreased community participation in malaria campaigns due to COVID-19 (1).

Despite the observed overall reduction of mosquito net ownership, results still suggest that a large proportion of SAC who own a mosquito net (1) usually use the net and (2) had slept under a mosquito net the night before the survey. This result calls for strengthened efforts in access to mosquito nets among SAC to achieve Tanzania's global goal of malaria elimination by 2030.

At the household level, in the 2021 SMNS study the observed slight difference between persons who owned any net and LLIN, wherein most of the respondents owned any type of net may be attributed to the fact that there is easy access to LLINs among communities through different existing channels. In addition, positive community response to mass distribution campaigns, school net programmes, immunization and antenatal care visits is key to the observed achievements.

4.5 Mosquito net sources

The school net programme was the most reported source of mosquito nets in the surveyed households. The results showed a 50% increase from the 2019 to 2021 SMNS survey in regards to school distribution as a mosquito net source (15.8% in 2019 and 34.3% in 2021). Although this indicates that the programme is scaling up(9), the 2021 SMNS found that mass distribution campaigns declined: from 45% in 2019 (9) to 30.2% in 2021. Therefore, efforts must be made to ensure consistent sustainability of every existing mosquito net distribution channel as each has a different, significant role in ensuring the targeted population is reached.

Although the school net programme was the most reported source of acquiring mosquito nets by SAC, it was the least reported source by SAC aged 5–8 years. This is because the programme targets SAC in class 3 and above. Moreover, there was a remarkable increase in access to mosquito nets from schools across epidemiological strata and geographical zones with high malaria burden (e.g. Lake and Western zones). This suggest that, along with positive community response toward reduction of malaria burden, malaria endemic areas should always be the priority in ensuring effective prevention of malaria transmission.

4.6 School absenteeism

In the 2021 SMNS survey, about 16% of the interviewed SAC reported having missed school in the two weeks prior to the survey; more than half of these SAC reported fever as the main reason for their absenteeism. It should be noted that fever could be due to malaria infection or other non-malarial febrile illnesses. With respect to age and gender, similar proportions of SAC reported being absent from school in the previous two weeks before the survey due to fever, other sickness and other reasons. Generally, absenteeism rates grew with increasing malaria epidemiological strata – absenteeism was lowest (7.2%) in the low malaria epidemiological strata and highest in the high malaria epidemiological strata. We also observed that SAC from high, moderate and low malaria epidemiological strata were more likely to be absent from school due to a fever as compared to SAC from very low malaria epidemiological strata. However, absenteeism in low and very low malaria epidemiological strata was relatively high due to other sicknesses. According to geographical zones, absenteeism was more prominent among SAC from Eastern, Southern, Lake and Western zones compared to Central, Southern Highlands, Northern and Southwest Highlands. Thus, our results are in-line with the National Malaria Strategic Plan 2021–2025, where zones with high school absenteeism were also shown to have high malaria incidence (16), indicating similar patterns between malaria burden and school absenteeism.

Other sicknesses were generally a cause of absenteeism among SAC in very low malaria epidemiological strata. There is evidence that fever due to malaria and other causes are known to affect SAC learning outcomes (51). Therefore, preventive strategies and

interventions that target febrile illnesses, including malaria, are likely to decrease school absenteeism and, therefore, support children's well-being and ability to achieve their full academic potentials.

4.7 Malaria knowledge

The SMNS survey also assessed the role of mass media communications to promote positive behaviour change to control malaria among SAC. Generally, low communication exposure was recorded among SAC – only 49.4% of the SACs were exposed to malaria prevention messages. In addition, only one-third of the SAC were exposed to malaria testing and treatment. Exposure to malaria messages also varied across regions, with Pwani, Lindi, Tabora, Mara and Dar es Salaam having the most exposure and Songwe, Rukwa, Iringa, Tanga and Kilimanjaro having the least. This calls for an increase in advocacy to regions where malaria prevalence is still high but exposure to malaria messages is low.

Overall, radio was the most cited source of malaria message exposure followed by schools (books and teachers) and television (only for SAC aged 9–16 years). These results are in line with the 2019 SMNS Survey (9) and the 2017 Tanzania Malaria Indicator Survey (4), which reported radio as the most common source of information across all education levels and wealth quintiles in women of reproductive age (15 – 49 years) in Tanzania. Even though schools were cited as the second most common source of exposure among SAC, only 38.9% of SAC were exposed to messages at school and less than one-third were exposed to both malaria testing and treatment messages. The observed lower exposure to malaria messages in school settings calls for more efforts to ensure that school health programmes are incorporated into school curriculum to enable SAC to understand public health issues.

Newspapers and posters were the least mentioned sources of malaria information among SAC, which may be attributed to a poor reading culture, lack of visual attraction of newspapers among SAC and limited availability and accessibility of newspapers and posters in remote areas. Nevertheless, a study conducted by Manga, I.A et al, in Dakar has been suggested that the use of playful teaching materials (like animation) in schools could be a good way to raise awareness amongst SAC about malaria and other public health problems (52).

The National Malaria Strategic Plan aims to maintain high knowledge of and improve good practices amongst vulnerable groups with elevated risks of malaria infections so that they know about their specific risks, prevention and available treatment options (16). The 2021 SMNS survey found that a high proportion of SAC were aware of malaria transmission methods; however, their overall knowledge on prevention and treatment methods is lower compared to the national target of 90.0% (16). The knowledge SAC have is attributed mostly to exposure of malaria messages through radio and television, whilst schools, books and teachers lag as a source of malaria knowledge to SAC. Therefore, efforts are required to incorporate public health studies be into the school curriculum.

The ability to reach the population with information and educational messages is a key element of the malaria elimination agenda. However, the exposure of target populations to specific messages is the primary goal of behaviour and social change communications. Increasing the knowledge of malaria messages amongst SAC through various channels, such as radio, television, printed materials and community events, contributes to changes in attitudes and

practices related to malaria prevention methods (4). Generally, the exposure of the heads of household to any malaria messages was below 80.0%. The lowest level of exposure was recorded in the slogan, *Ziro malaria inaanza na mimi* (40.3%), which we mainly attribute to education level of the head of household, i.e. the least exposure was recorded in households with only primary or no education. Therefore, increased harmonization at all levels is crucial for raising the overall status of exposure.

4.8 Anaemia

Anaemia is a key indicator for health and nutritional status among SAC. It is a result of many factors, including inadequate intake and utilisation of micronutrients, infections like malaria and intestinal parasites (28,53). In the 2021 SMNS study, anaemia prevalence amongst SAC was 32%, which was slightly lower than the 34% recorded during the 2019 SMNS survey.

Variation in anaemia prevalence was observed across age groups, sex, malaria epidemiological strata, altitude, geographical zones and regions. High prevalence of anaemia was observed among SAC aged 15–16 of both sexes, compared to other age groups. However, girls had the highest prevalence of both severe and moderate anaemia compared to boys of the same age group. Girls are usually more likely to be anaemic after the onset of menarche due to the increased demand for iron. For example, a study in Nepal amongst adolescent aged 10–19 years also observed a higher anaemia prevalence in girls than boys (54). Higher prevalence of anaemia amongst older children might be associated with their ongoing rapid physiological changes involving intense growth and development leading to increased demand for iron and other nutrients to counteract the additional nutrients requirements during puberty (54–56).

A higher prevalence of anaemia was also observed in SAC living in lowlands, as was a higher malaria burden strata, which was similar to the findings from the study conducted in Nepal, whereby SAC living in the lowland also had a higher prevalence of anaemia compared to those living at higher altitudes (54). Furthermore, anaemia was more prevalent in the lowland areas characterised by the high prevalence of malaria infection (57). Malaria in turn causes anaemia by haemolysis of infected and uninfected erythrocytes and bone marrow (58). Therefore, populations living in lowland areas with high malaria transmission are more likely to suffer from anaemia caused by malaria infection, as demonstrated in the 2021 SMNS. We also observed zonal and regional differences in the 2021 survey. Some regions revealed a higher prevalence of anaemia, even when levels within their zone were generally low. Within regions, some councils recorded very high levels, whereas others reported very low levels; as a result, regional prevalence may not represent the actual situation in councils.

4.9 Nutrition status and school environment

Most schools in Tanzania do not implement the SFP; however, there are marked variations in the availability of enabling SFP components across councils. According to the 2021 SMNS, school infrastructure, which is among the basic components of the SFP demonstrated disparities in its availability and quality. On the other hand, the survey results described that inadequate water, sanitation and hygiene services might be the contributing factors in low availability of the SFP.

To ensure effective operation and availability of the SFP, the schools' board which is composed of parents/guardians should oversee/coordinate the SFP in public primary schools. The SMNS survey found that most schools that reported having the SFP had complied with this recommendation, not only forming the committee, but allowing it to be the main coordinator of the SFP. The committees which include parents as the major custodian, usually work diligently with the school administration to provide advice, maintain the schools' prosperity and ensure efficiency during implementation. Therefore, having such committees at schools may ensure sustainability of the SFP in schools with SFP. However, it is noteworthy that contrary to the national guidelines, the 2021 SMNS revealed that nearly 40% of schools reported that either head teachers or health teachers were the main SFP coordinators.

Although highest percentage (85.3%), of all classes among the surveyed schools were getting meals at school; the survey revealed that children in examination classes (i.e. class 4 and class 7) benefitted the most from school meals. The findings did not determine what meal(s) children were provided, breakfast, lunch or both. Furthermore, the SMNS did not determine if the supplied food was a meal or snacks. Hence, there is a need to assess how food is supplied in terms of its quantity and quality.

The findings revealed that buying food from the market (87.8%) and parents' contributions (83.4%) were the main sources of food to implement the SFP. This contradicts other findings which pointed to low community participation as a major hindering factor for implementing the SFP (59). This might be due to by-laws that force parents to contribute food. The SMNS was also unable to establish the source of money used to buy food at the market.

The observed low community participation is one of the major hindering factors (77.9%) in SFP implementation, which signifies that community participation is the crucial factor to facilitate effective and sustainable SFP in public primary schools in Mainland Tanzania. Furthermore, the low awareness (30.2%) of the SFP might contribute to poor SFP implementation. This suggests the need for interventions that focus on community sensitization about the usefulness of the SFP to increase community participation, which will enhance SFP implementation and sustainability in Mainland Tanzania.

Overall, the surveys result point to a need to advocate for holistic implementation of SFP, which goes beyond providing only school meals. Further, the survey showed the need for schools, at minimum, to have a supporting or enabling SFP environment, such as clean water, dining, stores and a hand washing station.

Acute malnutrition

A 2019 study by Lillie, M. et al. assessed the difference between body mass index (BMI) for age and MUAC as a means of assessing nutrition status in SAC. The study found that BMI and MUAC had positive correlations, mainly among older girls than boys (60). Although this study was small it provides evidence based on MUAC assessments as an indicator for nutritional status in SAC.

Based on MUAC findings, the prevalence of acute malnutrition (i.e. undernutrition) in SAC surveyed for the SMNS was 20.2%, with undernutrition more prevalent in boys, mainly aged between 15–16 years. In the 2019 SMNS, the prevalence of undernutrition among SAC was

16.2% and boys were found to be more undernourished than girls. This is consistent with the fact that boys are more likely to become malnourished than girls because of their biological, behavioural and sociocultural characteristics (61).; however, as described earlier, the methodology used in assessing nutrition status in the SMNS 2019 was different to that used in 2021.

Overweight and obesity

The prevalence of obesity in SAC was 3.8%, which is lower compared to the 2019 SMNS, which found that about 5.1% of all SAC were overweight or obese. The prevalence of overweight or obesity was higher among girls than boys. The findings is similar to other studies which were conducted in SAC aged 5–19 years in urban and rural areas which showed that girls are more likely to be obese than boys (62) or presented gender differences in child obesity prevalence (63). This may be attributed to a society weight beliefs, behaviour, poor diet and low physical activity (63). The presence of obesity in SAC reinforces the country's need for improved prevention strategies, in particular because SAC who are overweight or obese are more likely to experience non-communicable diseases, which would increase their disease burden in adulthood. Another factor to consider is the limited availability of sufficient playgrounds, both in quantity and quality, which may contribute to SAC's limited exposure to physical activities. Interventions addressing this issue should target behavioural nutrition, physical activity, playgrounds at schools and school feeding guidelines for SAC.

It must be noted that the current study's findings must be interpreted with consideration to its limitations. First, the 2021 study did not consider the impact of health status or potential morbidity/mortality concerns. Furthermore, because MUAC does not consider body composition, it may be a restricted tool for detecting obesity in children with low skeletal muscle mass. As a result, our findings, which reflect the general population rather than at-risk populations, are significant. Second, even though the participants were systematically sampled at each school, the study sample was drawn from only a few wards in one council and was not necessarily representative of primary schools in the country.

Chapter 5: Challenges and study limitation

5.1 Operational challenges

1. The delay in the SMNS's commencement due to the nationwide COVID-19 vaccination campaign resulted in missing surveying class 7 SAC, which affected the overall age distribution. In some regions, the nationwide COVID-19 vaccination campaign was done in parallel with the SMNS 2021 survey, which resulted in the same regional and district staff involved in both activities leading to delayment of either start or finish of the SMNS. Future planning of the SMNS surveys should assess potential collisions with other surveys or mass campaigns to optimise the quality of the survey results.
2. Some selected households were too remote to access due to poor infrastructure. In this case, reselection and replacement was done.
3. Researchers experienced low cooperation in some communities by parents and guardians due to negative perceptions toward the survey, as it was related to the national COVID-19

vaccination campaign. Considering the usefulness of the information generated from this survey, the MoH and NMCP should support creating awareness within communities prior to its implementation to clear any misconceptions.

4. Limited incentives for key personnel, such as school committees and community leaders who are representatives of parents at school, resulted in minimal engagement and support of the survey. This needs to be considered in future surveys.

5.2 Study limitations

1. Although the information on mosquito net coverage, use and access was obtained, the quality of mosquito nets at the household level was not assessed.
2. The survey did not gather information on reasons for not using mosquito nets among SAC, which would enrich the explanation on low net use among SAC.
3. The survey did not account for seasonal variation as a way of identifying risk factors associated with prevalence of malaria.
4. Although data were collected from the head teacher about the SFP, the questionnaire did not involve the key stakeholders (e.g. parents/guardians and PO-RALG), which limited the findings. Similarly, surveyed schools that do not implement the SFP were not surveyed on the reasons hindering SFP implementation in their school.

Chapter 6: Conclusions and recommendation

6.1 Conclusions

The cross-sectional SMNS study provides rapid, reliable and complementary data to inform planning and implementation of interventions targeting malaria, malnutrition and anaemia amongst SAC. We observed that most SAC had asymptomatic malaria infections, which may lead to a reservoir of malaria that perpetuates transmission to vector mosquitoes and maintains ongoing transmission to the population. We observed high malaria infection in areas with high malaria endemicity, low altitude and older children. Generally, the reported proportions of mosquito net ownership and use, as well as knowledge of malaria prevention, transmission and treatment were high, particularly in areas with high malaria burden, suggesting targeted interventions have reached areas of high malaria endemicity. In general, moderate access to LLINs was recorded at the household level with variation across the regions, while high access to LLINs was observed in high malaria burden areas.

School absenteeism was substantially low, with the majority of absentee SAC living in high malaria epidemiological strata and Western and Southern Highlands zones where malaria burden is high. The most common reason reported for SAC missing school was fever. One-third of the surveyed SAC were anaemic, which calls a public concern. Malaria prevalence and anaemia were found to coexist with marked variations across regions. Further, acute malnutrition was found to coexist with anaemia with an alarming proportion of SAC having acute malnutrition with variation across regions.

The findings from the 2021 SMNS survey contributed to closing the information gap about the status of the school health environment, feeding practices and dietary quality of food that is accessible and available for SAC. The information obtained will be relevant to guide developing initiatives, guidelines, policies and other nutrition-related interventions targeting SAC.

6.2 Recommendations

Based on the findings obtained from the SMNS survey, we suggest the recommendations below for improvement of the malaria and nutrition situations in Tanzania.

1. Operational research is required to accomplish the following:
    a. Evaluate new or improved tools and strategies to address the problem and consequences of asymptomatic malaria infections to improve SAC health and accelerate malaria control and elimination. Tools and strategies may include single low dose use of primaquine (single low-dose), chemoprevention, seasonal malaria chemoprevention, intermittent preventive treatment in children, intermittent screening and treatment, improved integrated vector control, targeted mass drug administration and programmatic implementation of the RTS, AS01 vaccination.
    b. Determine the drivers for persistence of hyper- and holoendemic malaria (in schools), asymptomatic infections and low use of mosquito nets in some regions, councils and sub-councils despite the high coverage of interventions.

c. Establish the non-nutritional causes of anaemia (e.g. inadequate health care services, worm infestation and genetic factors).

d. Assess the effective use, integrity, efficacy and durability of vector control tools, particularly LLINs, and monitor emerging insecticide resistance because malaria persists despite high mosquito net ownership.

2. The MoH, through the NMCP, in consultation with nutrition section services, should implement strategies to reduce the challenges of malaria-related and non-malaria-related anaemia in SAC.
3. There is a need for sensitization, advocacy and investment involving multi-sectoral stakeholders (e.g. policymakers, decision-makers, communities, private sector and media) at different levels to support implementation and sustainability of school malaria prevention and control, as well as the SFP to improve SAC well-being and academic performance.
4. Further research is required to establish etiology of the observed high prevalence of anaemia in SAC to inform proper intervention strategies.
5. More interventions are required to address the observed high prevalence of anaemia among SAC. Moreover, the proposed intervention must take into consideration the inequitable distribution of anaemia prevalence in the country during its design, roll out and evaluation.
6. The Government of Tanzania should initiate a policy to provide mass drug administration (MDA) for antimalarial drugs in SAC, focusing on regions/councils and schools with high malaria prevalence (e.g. >50%; hyper- and holoendemic) and their surrounding community(ies). MDA deployment should be in-line with invasive vector control interventions, including supply of LLINs, larviciding and IRS for burden reduction.
7. The End Malaria Council (EMC) should be advocated and implemented at all tiers of the health care delivery system in the country. The EMC is composed of different sectors, including health, agriculture, education, finance, public works and local government. It emphasises multi-sectorial collaboration to accelerate and advocate joint strategies and interventions for malaria control toward burden reduction and its eventual elimination.
8. The SMNS should be continued especially between the MIS to ensure regular monitoring of the malaria indicators and SAC nutrition status. The survey will provide essential information to the MoH and NMCP for evidence-based planning and intervention programming.

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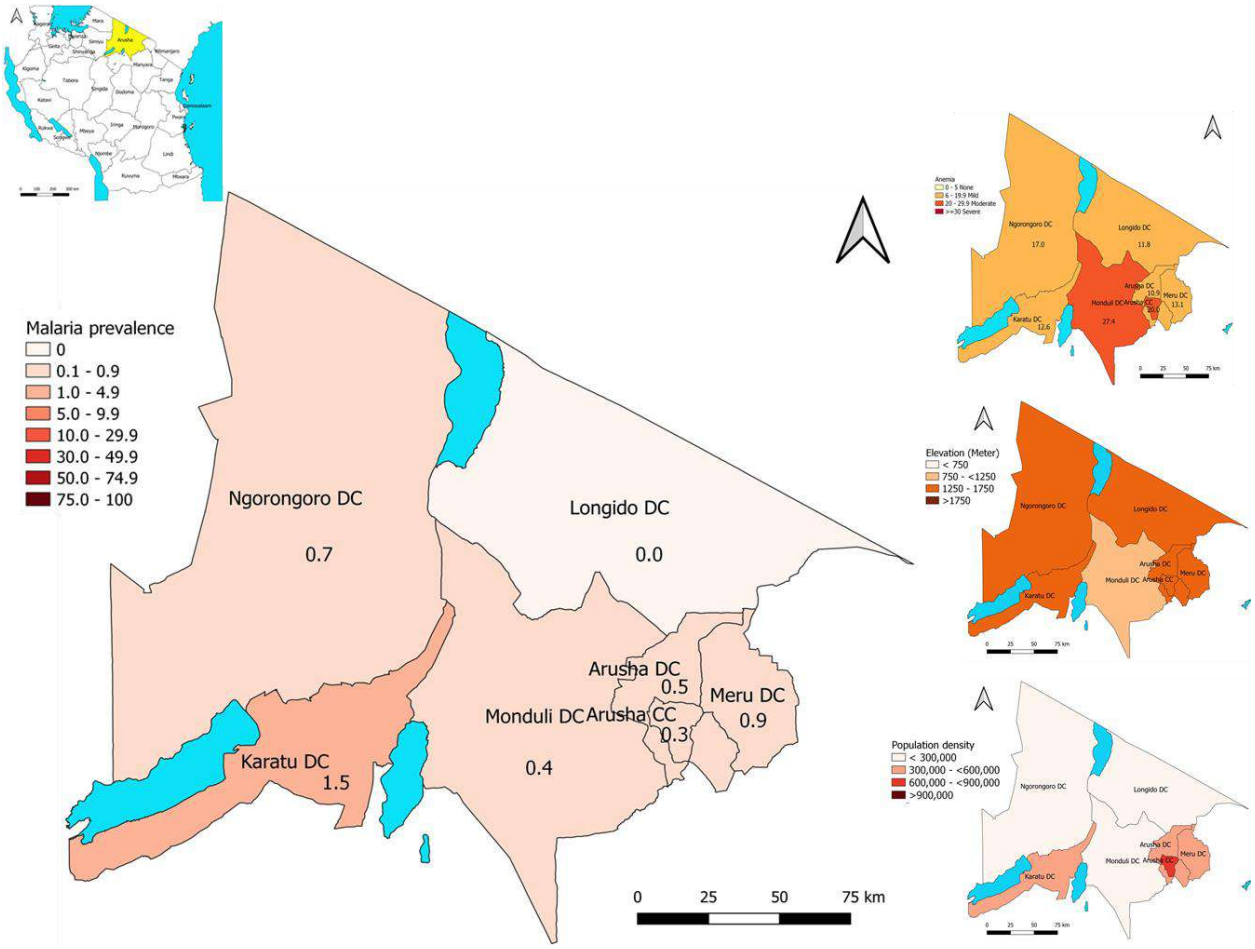
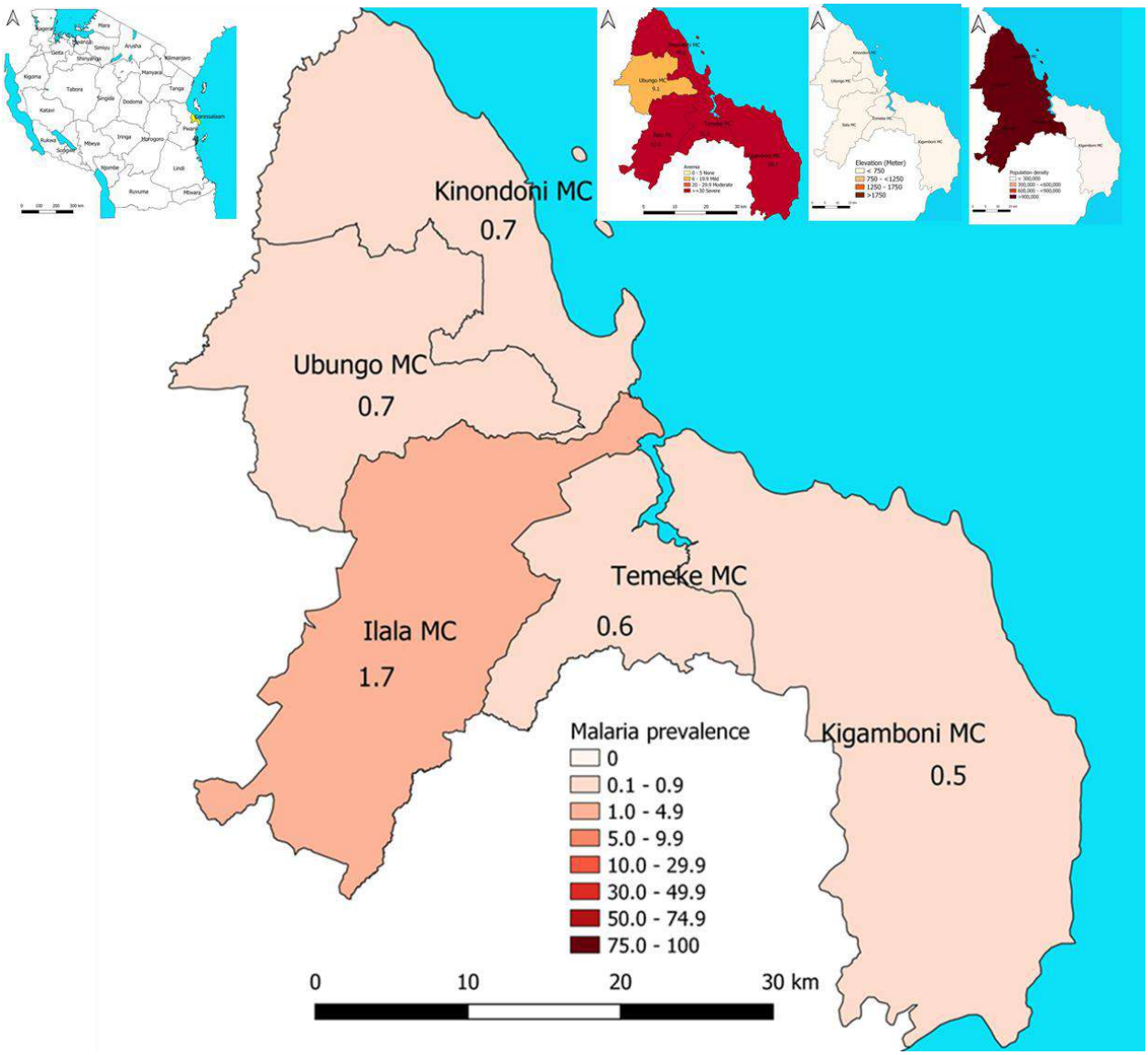
Apendix

The 2021 SMNS Regional Profiles

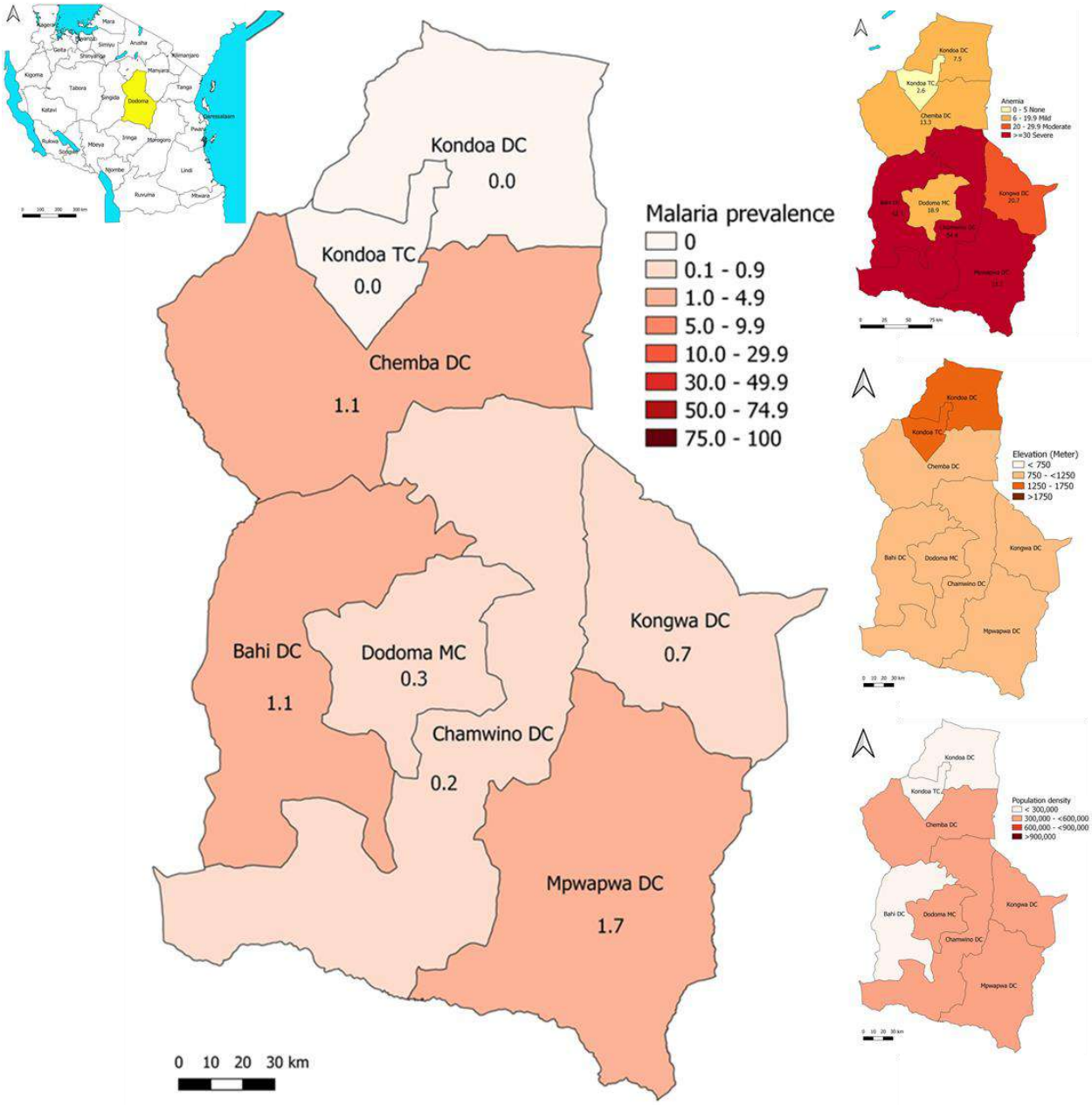
Appendix 1: The 2021 SMNS Regional Profile – Arusha



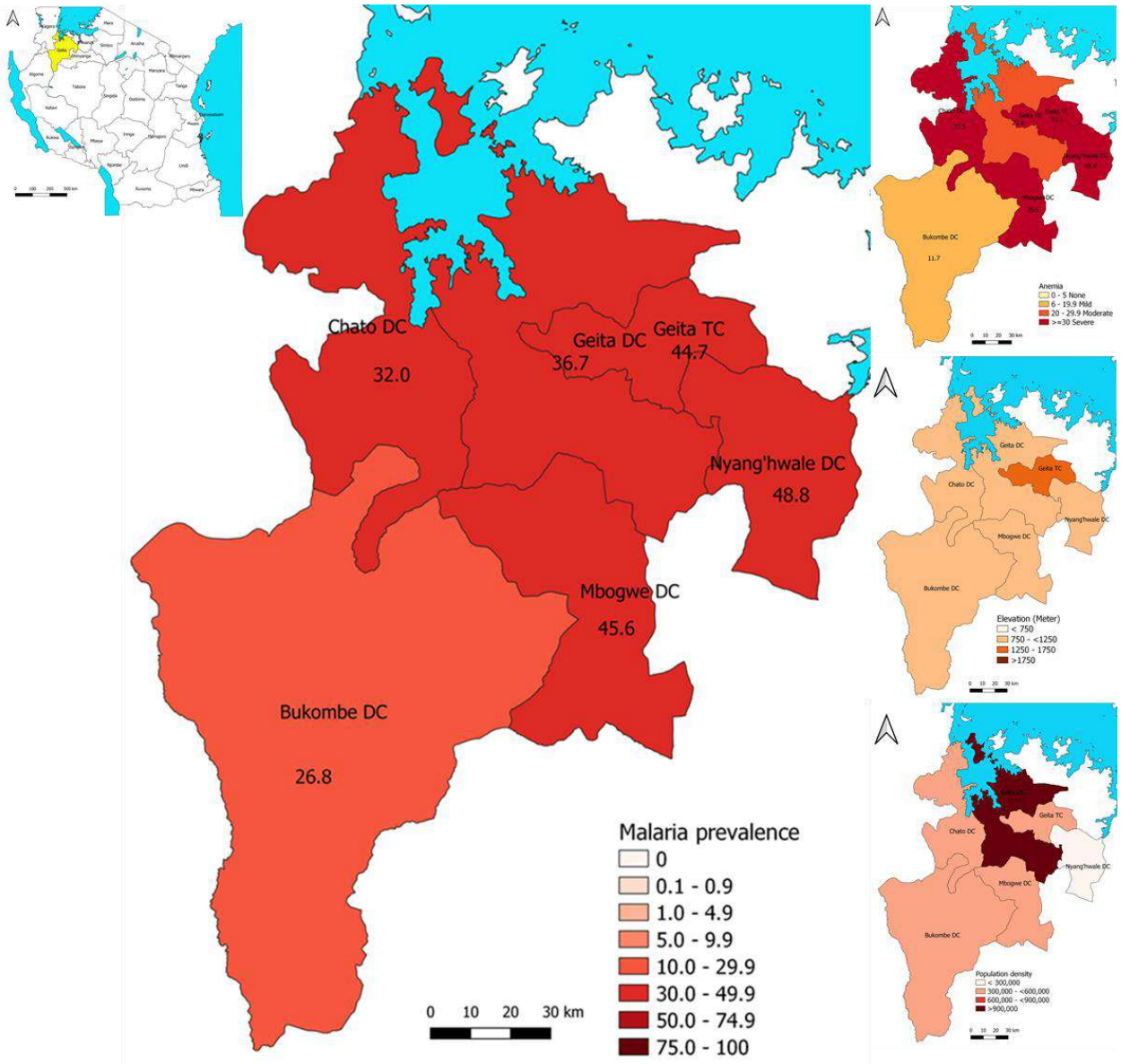
Appendix 2: The 2021 SMNS Regional Profile – Dar es Salaam



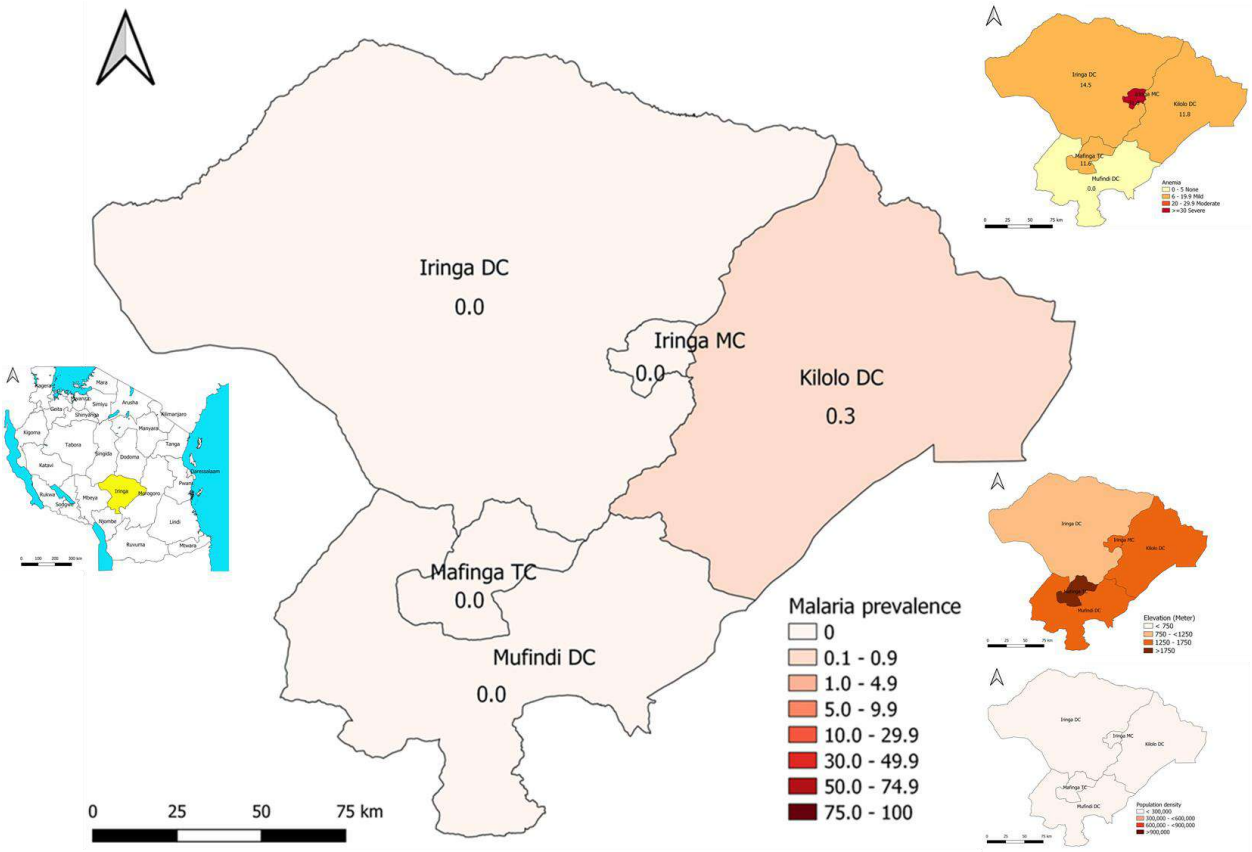
Appendix 3The 2021 SMNS Regional Profile – Dodoma



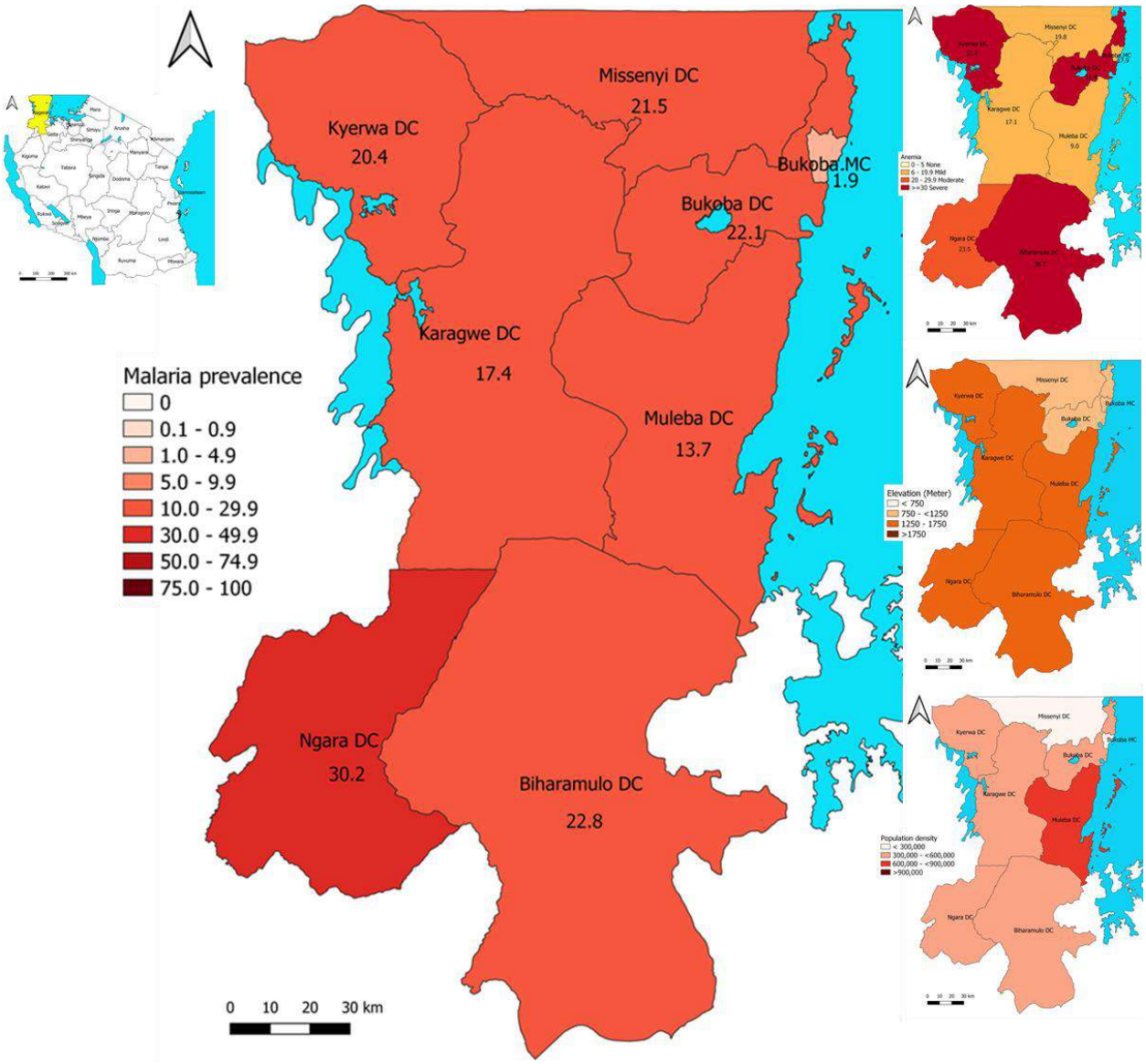
Appendix 4: The 2021 SMNS Regional Profile – Geita



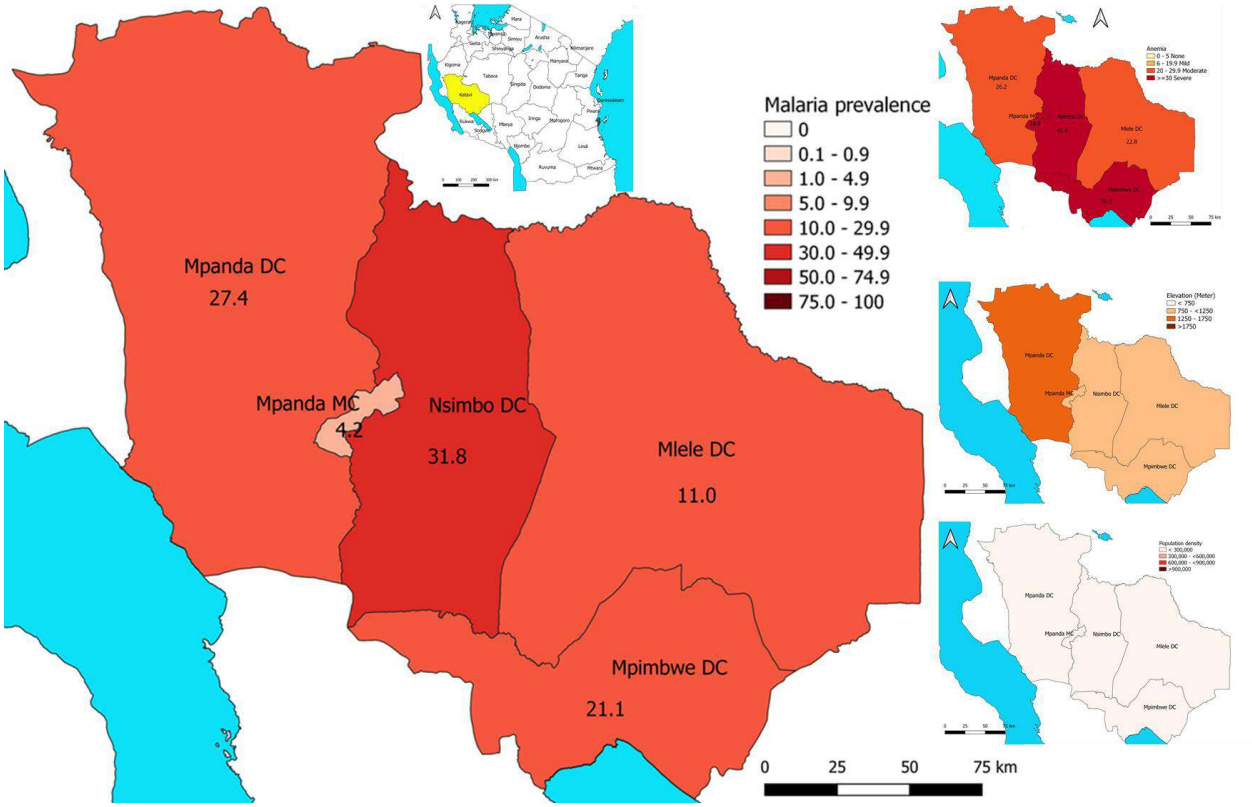
Appendix 5: The 2021 SMNS Regional Profile – Iringa



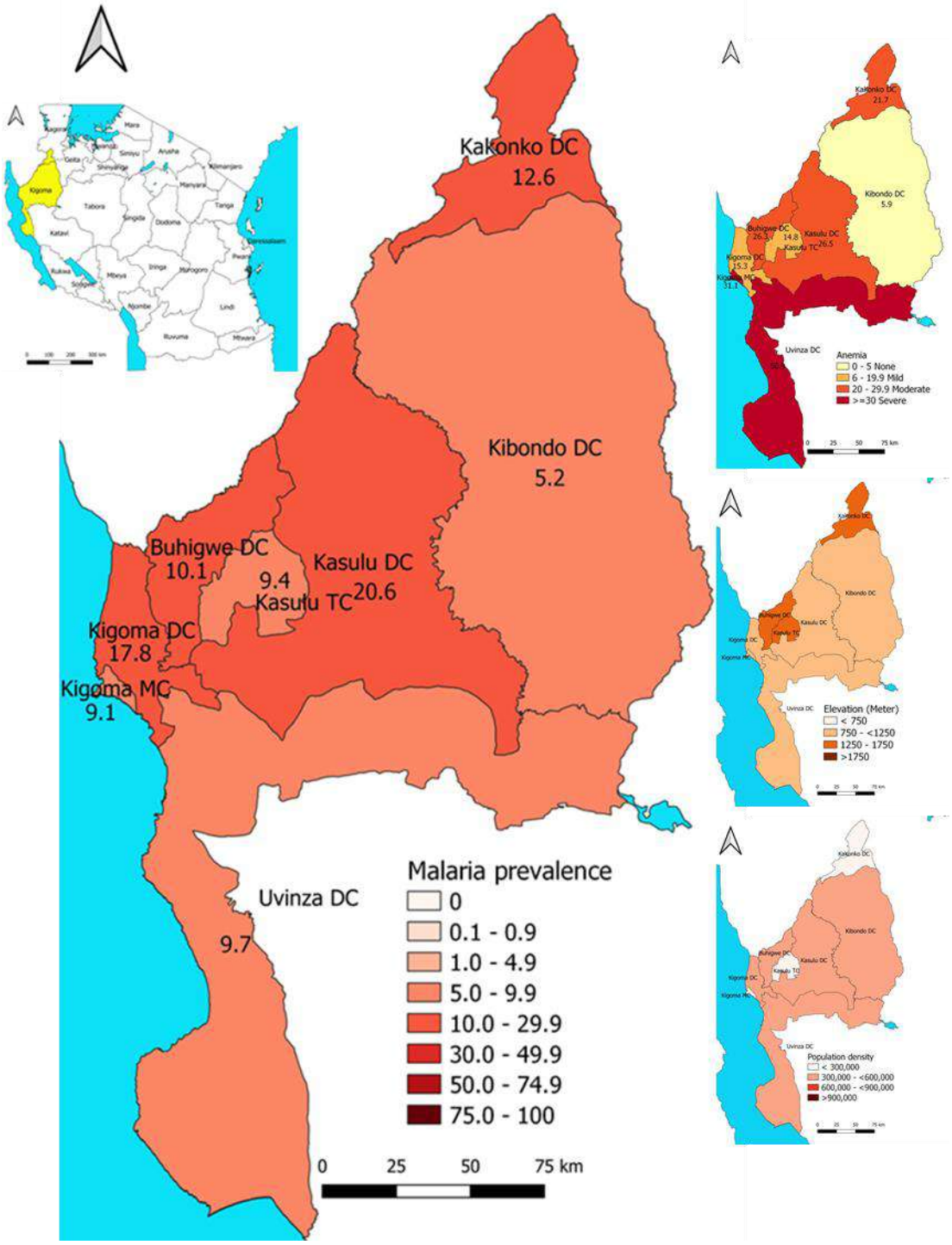
Appendix 6: The 2021 SMNS Regional Profile – Kagera



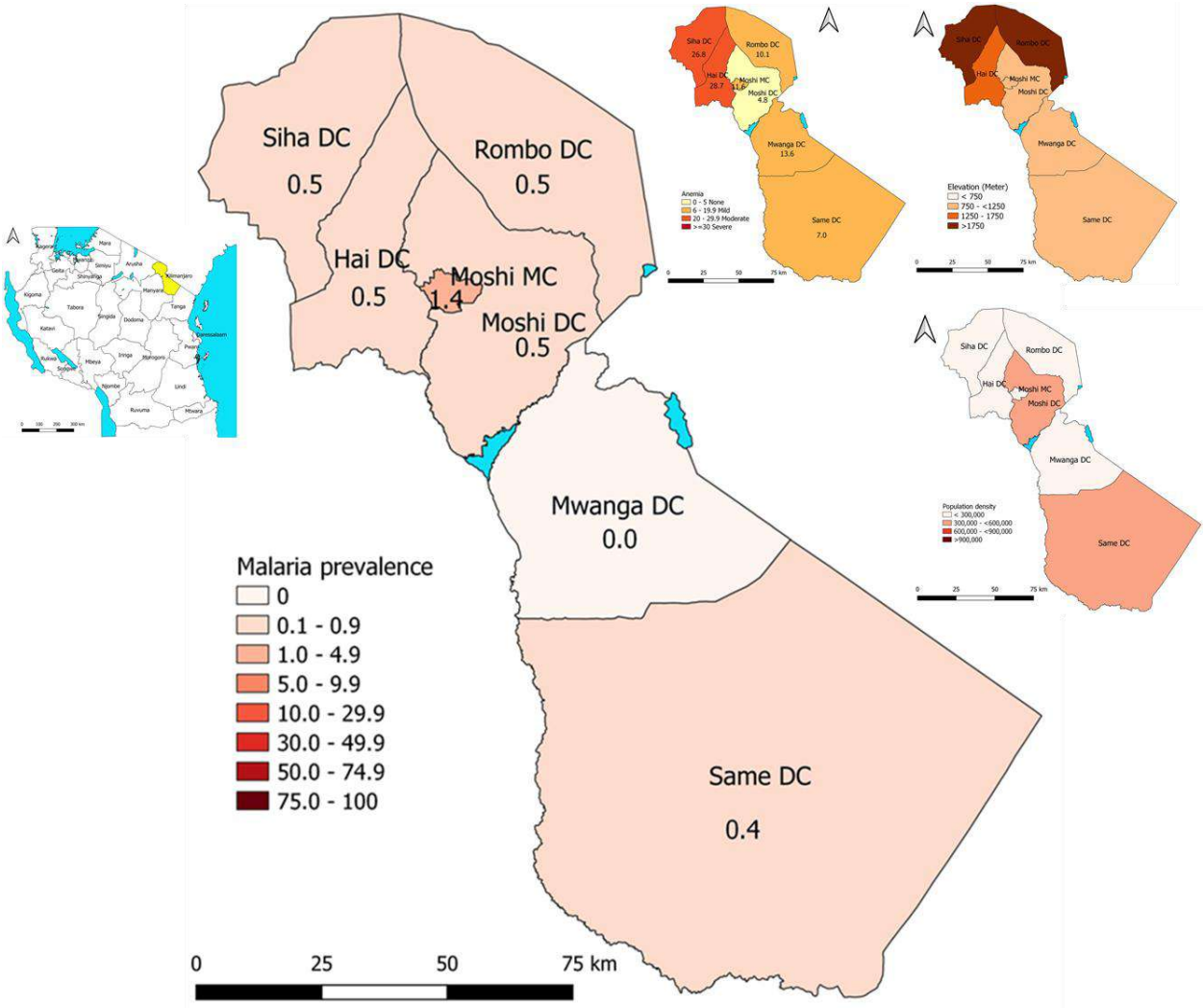
Appendix 7: The 2021 SMNS Regional Profile – Katavi



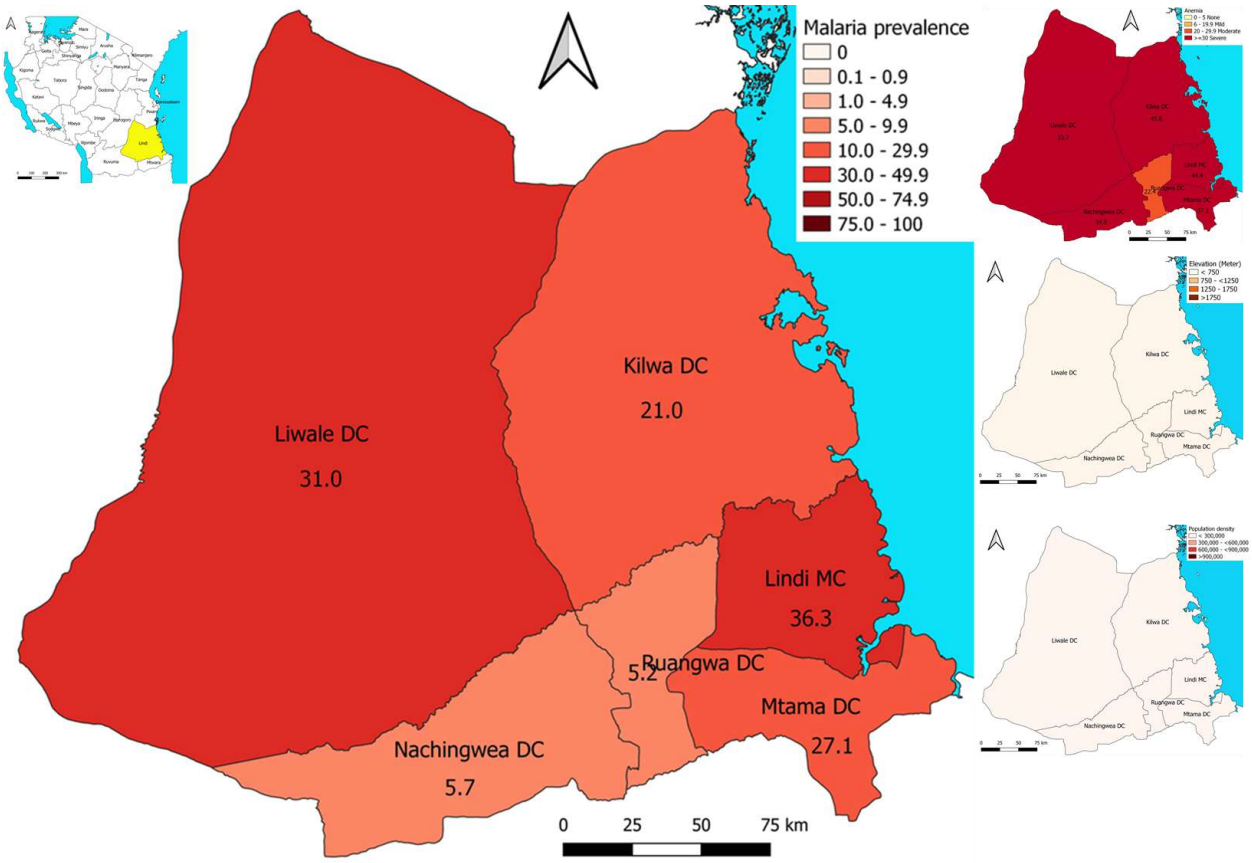
Appendix 8: The 2021 SMNS Regional Profile – Kigoma



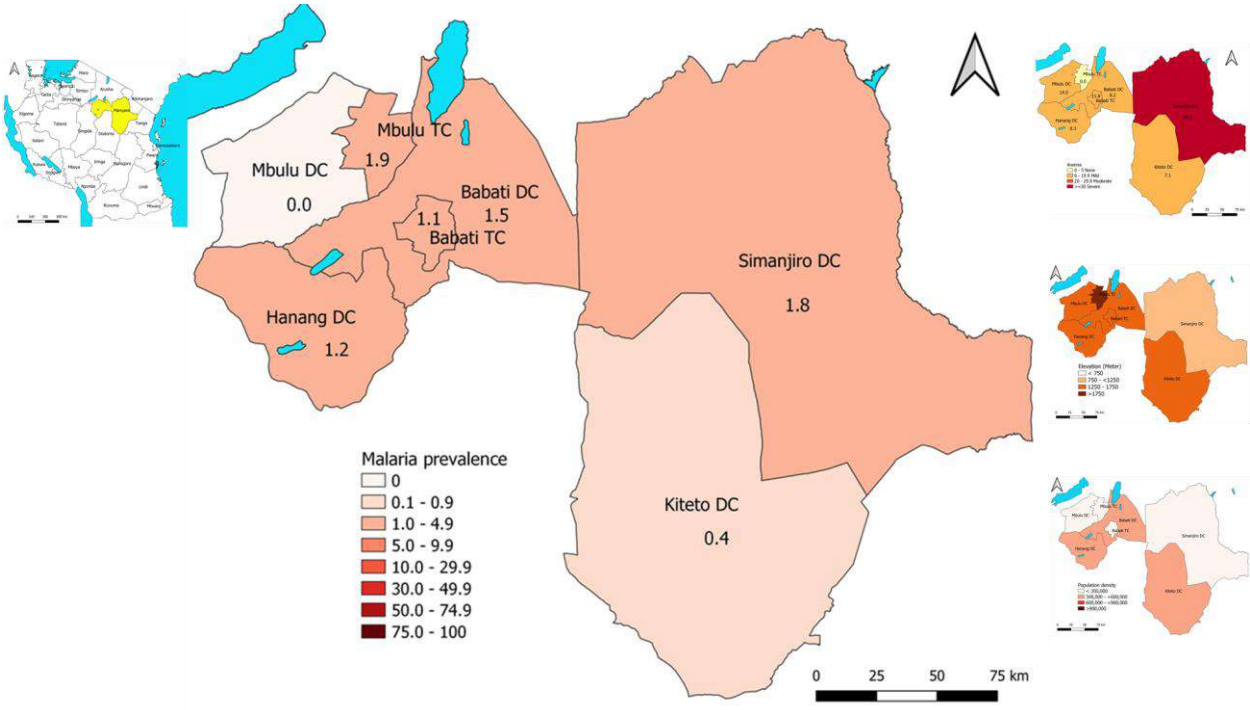
Appendix 9: The 2021 SMNS Regional Profile – Kilimanjaro



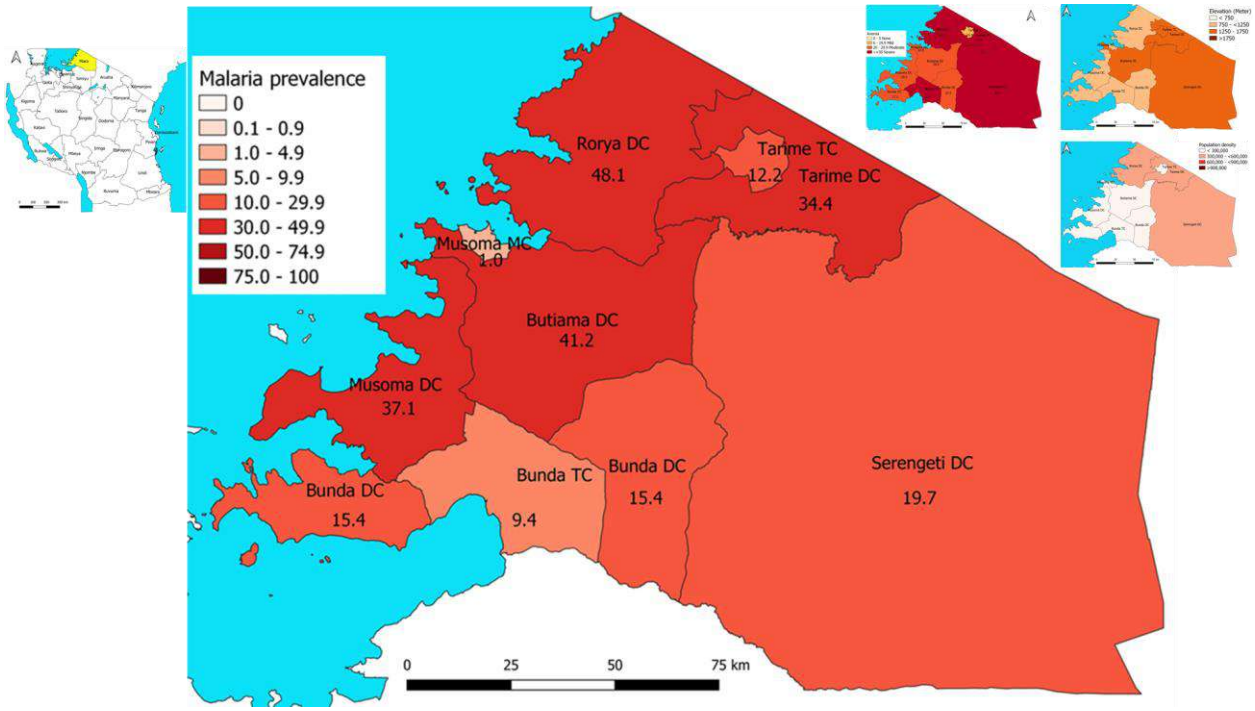
Appendix 10: The 2021 SMNS Regional Profile – Lindi



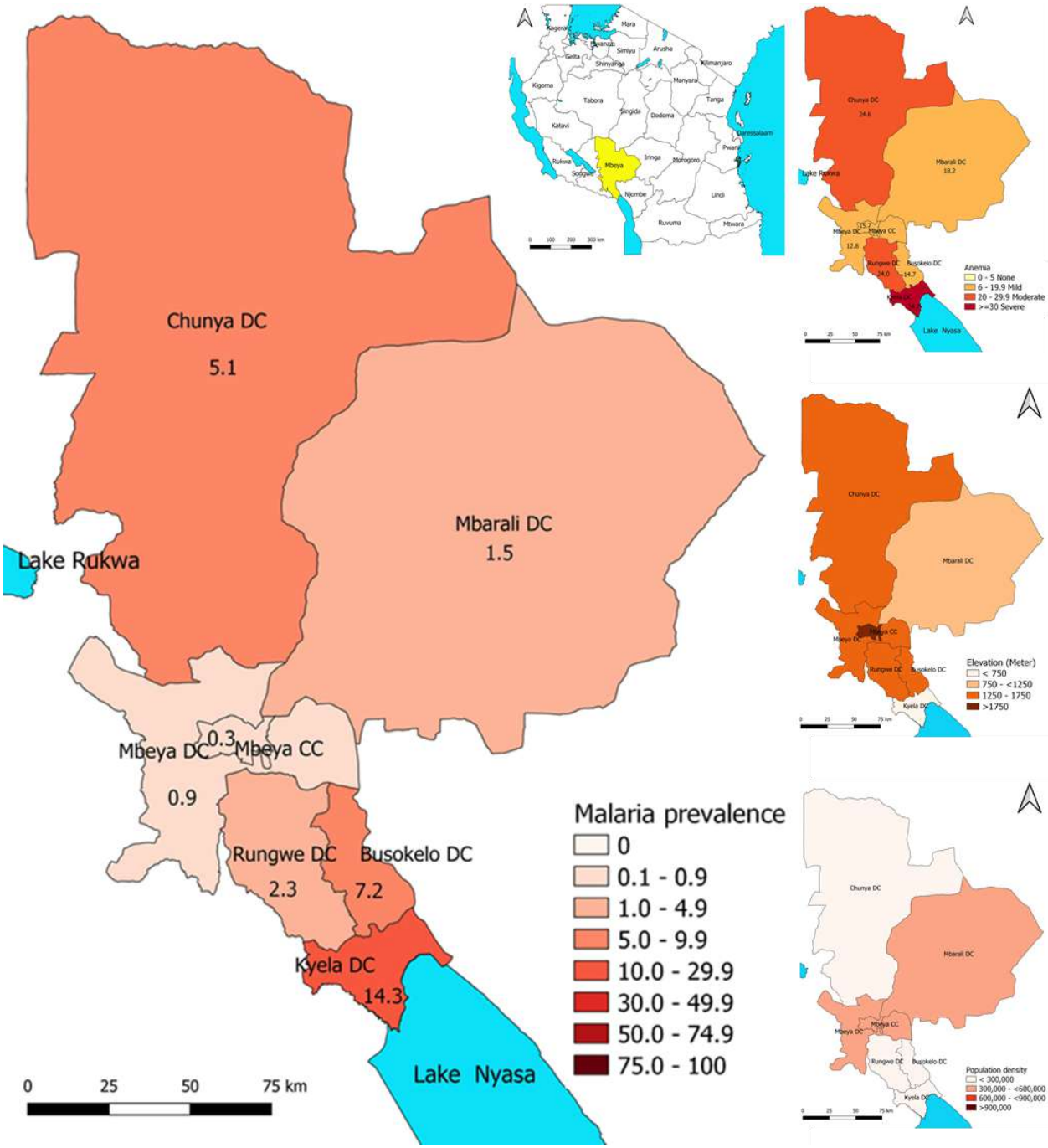
Appendix 11: The 2021 SMNS Regional Profile – Manyara



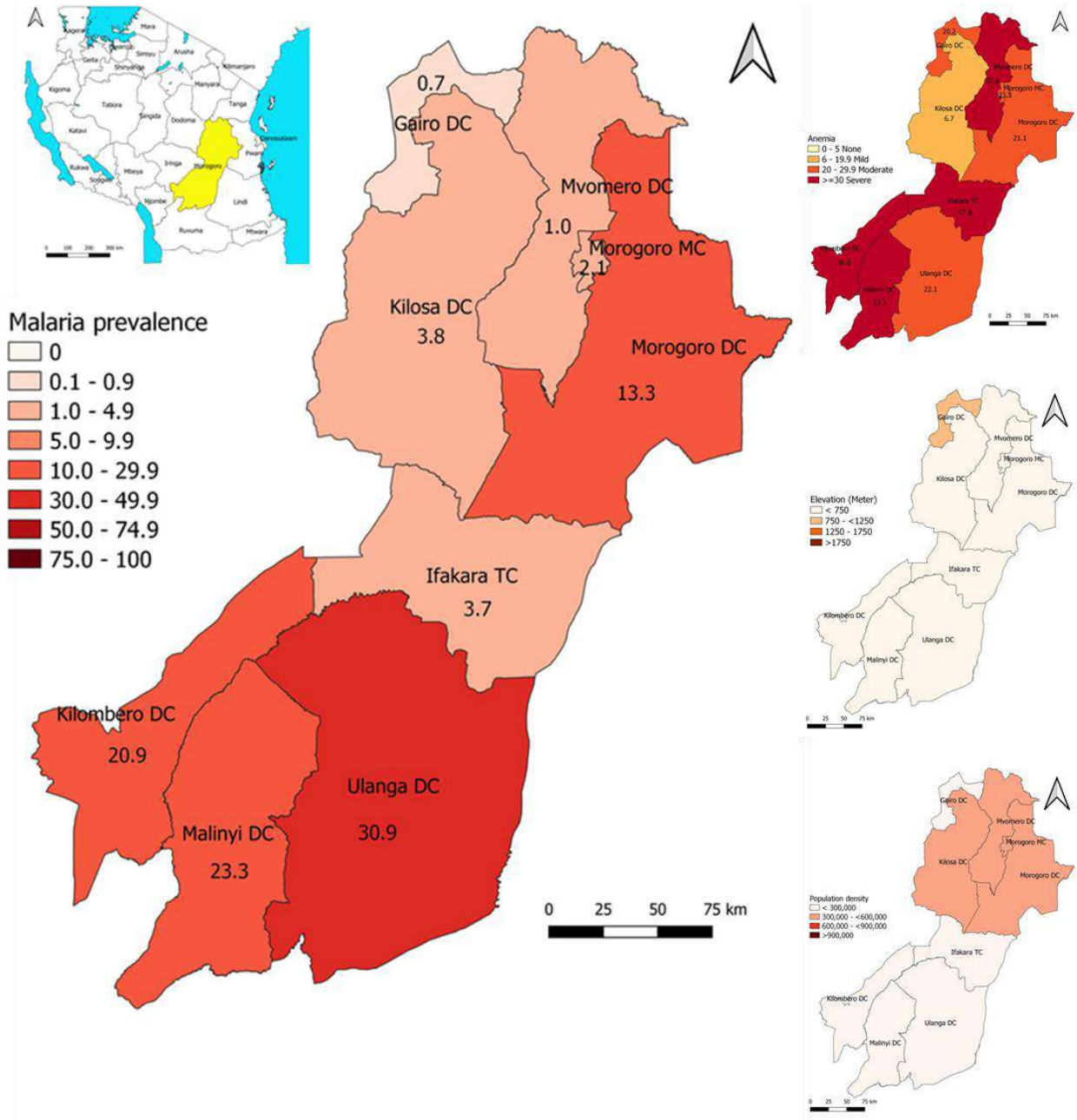
Appendix 12: The 2021 SMNS Regional Profile – Mwanza



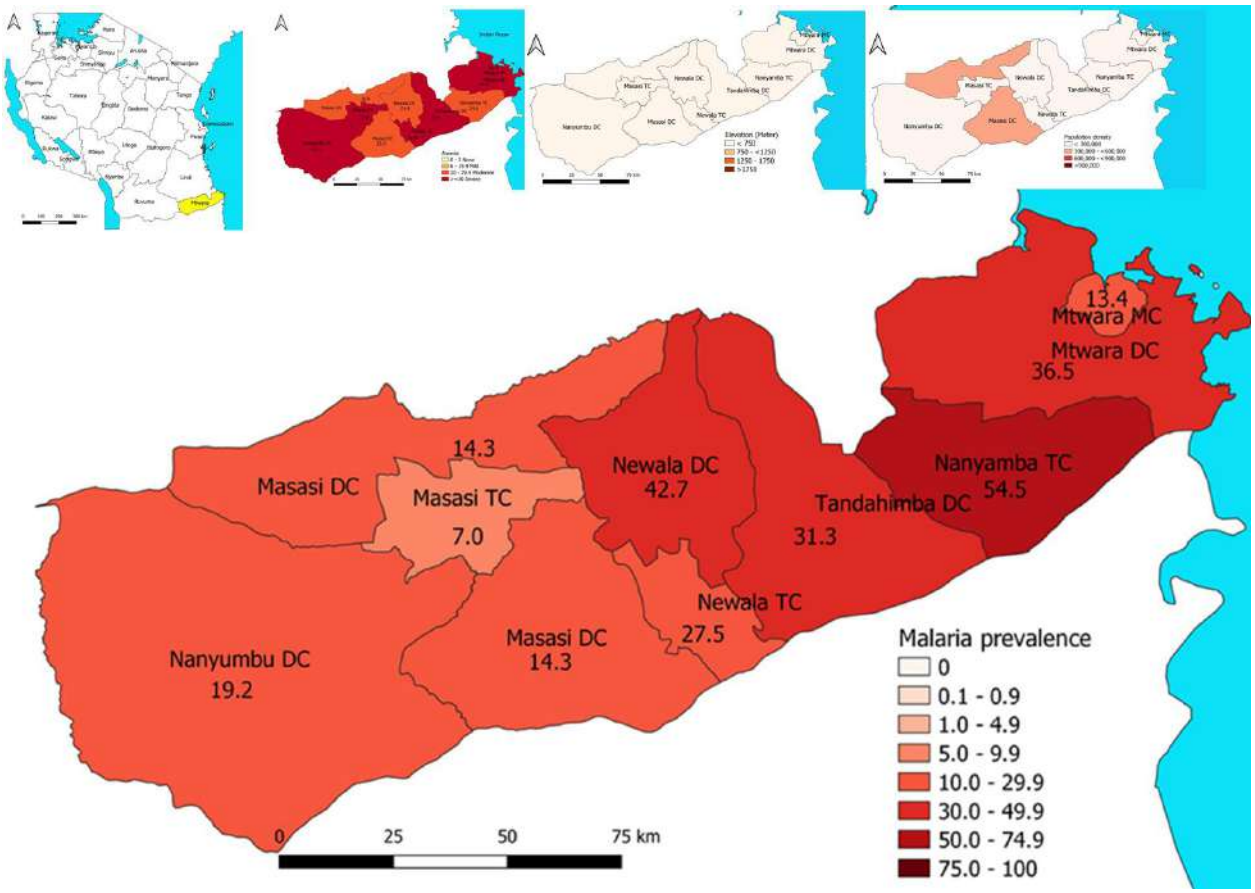
Appendix 13: The 2021 SMNS Regional Profile – Mbeya



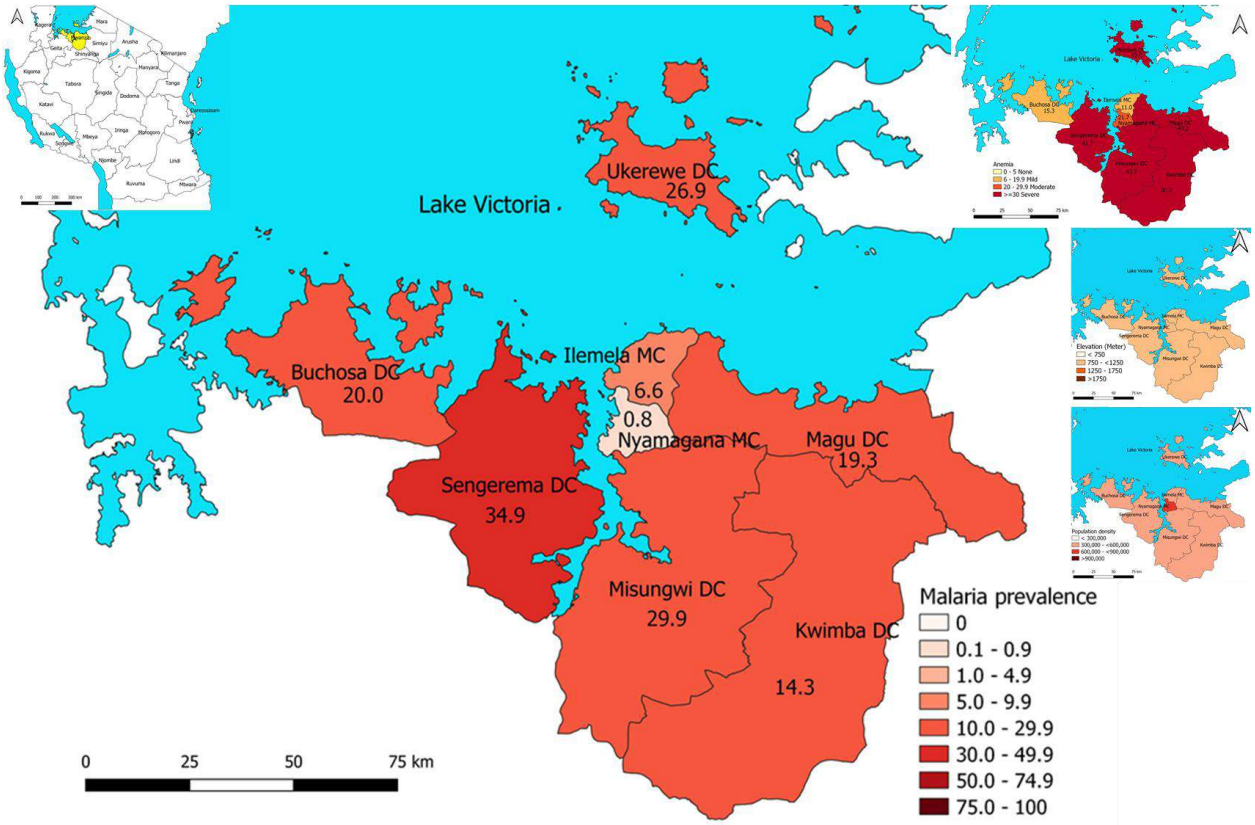
Appendix 14: The 2021 SMNS Regional Profile – Morogoro



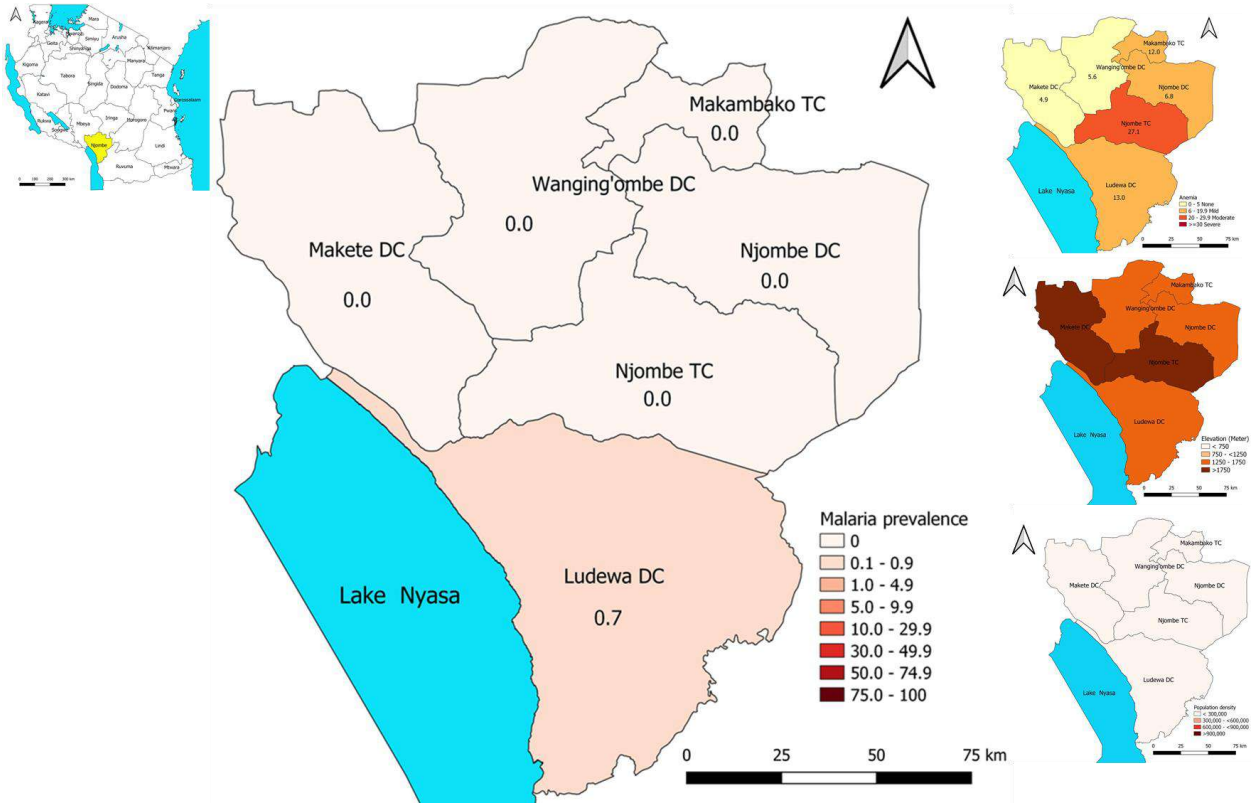
Appendix 15: The 2021 SMNS Regional Profile – Mtwara



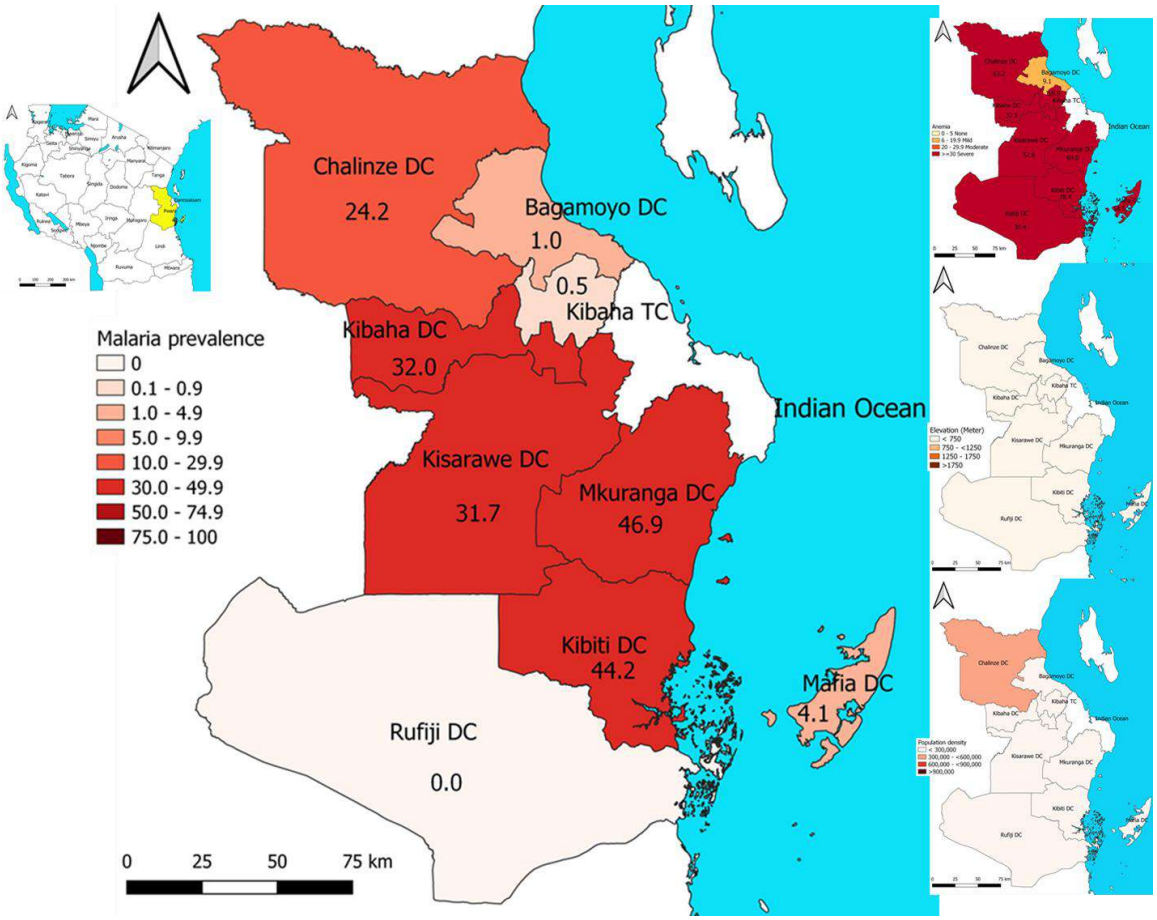
Appendix 16: The 2021 SMNS Regional Profile – Mwanza



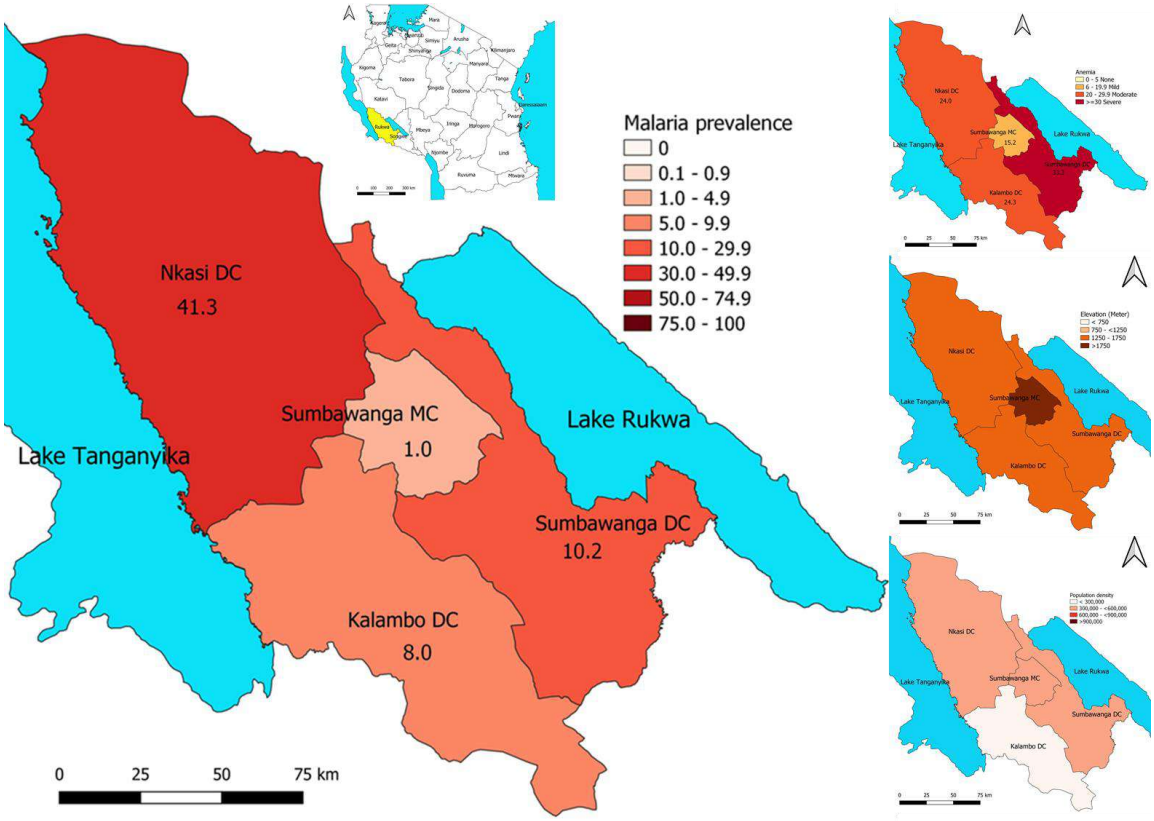
Appendix 17: The 2021 SMNS Regional Profile – Njombe



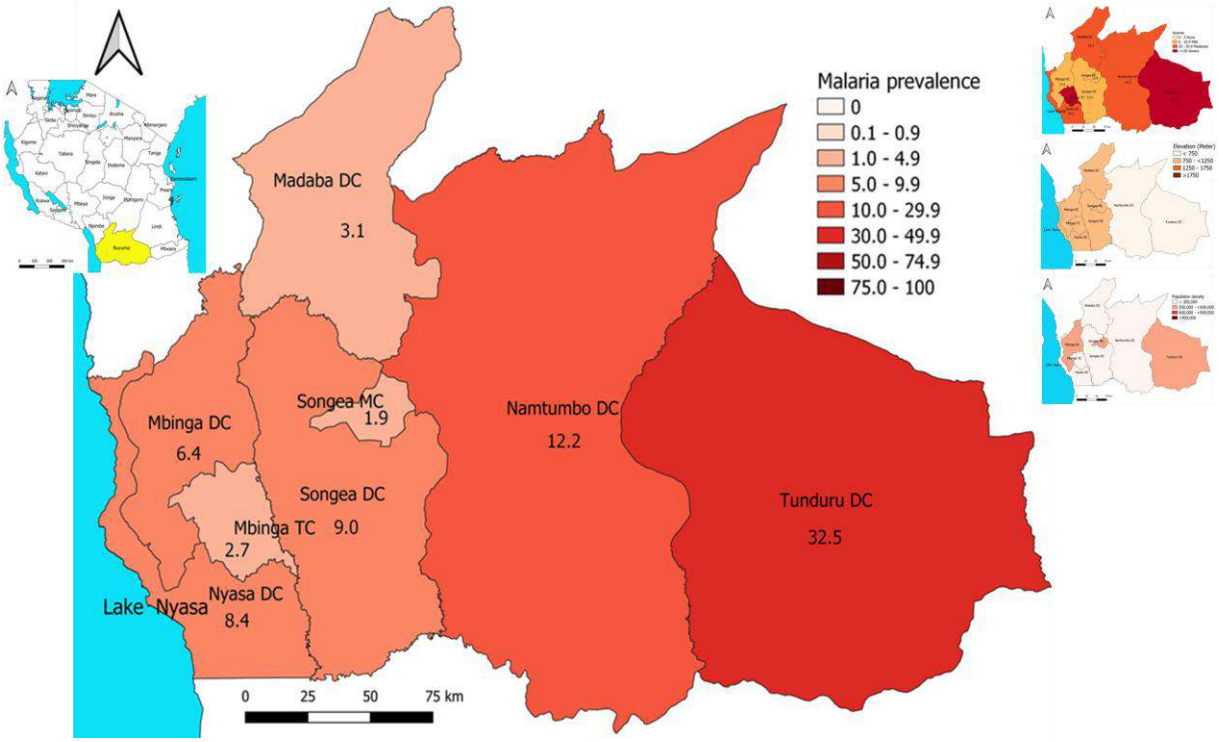
Appendix 18: The 2021 SMNS Regional Profile – Pwani



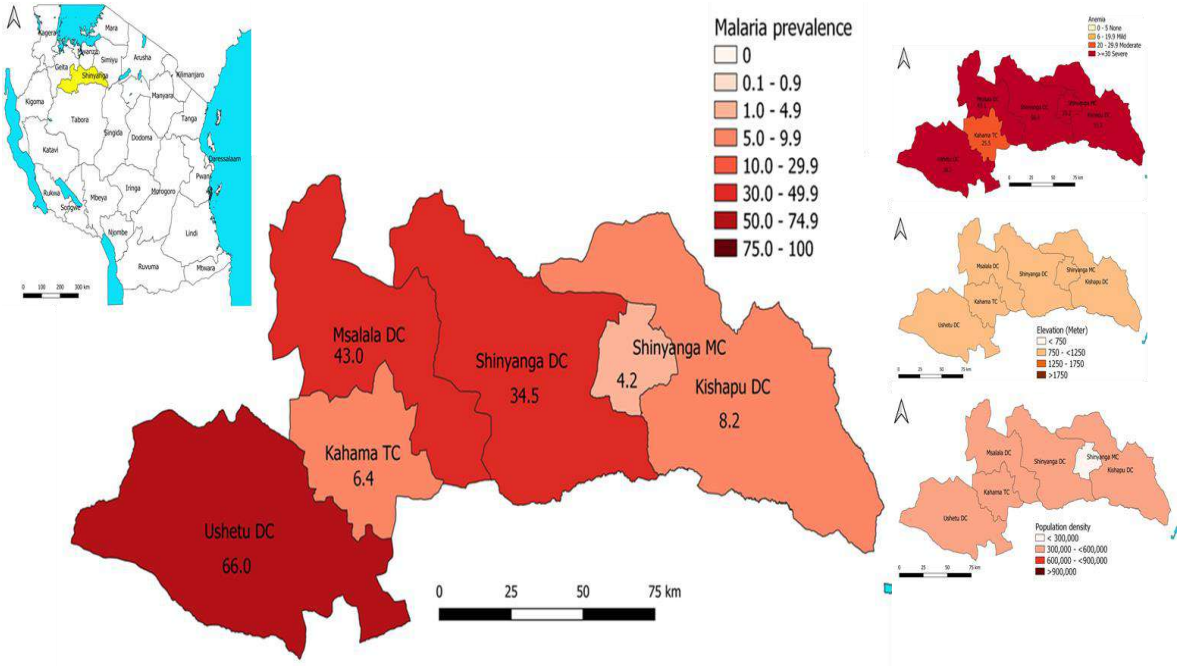
Appendix 19: The 2021 SMNS Regional Profile – Rukwa



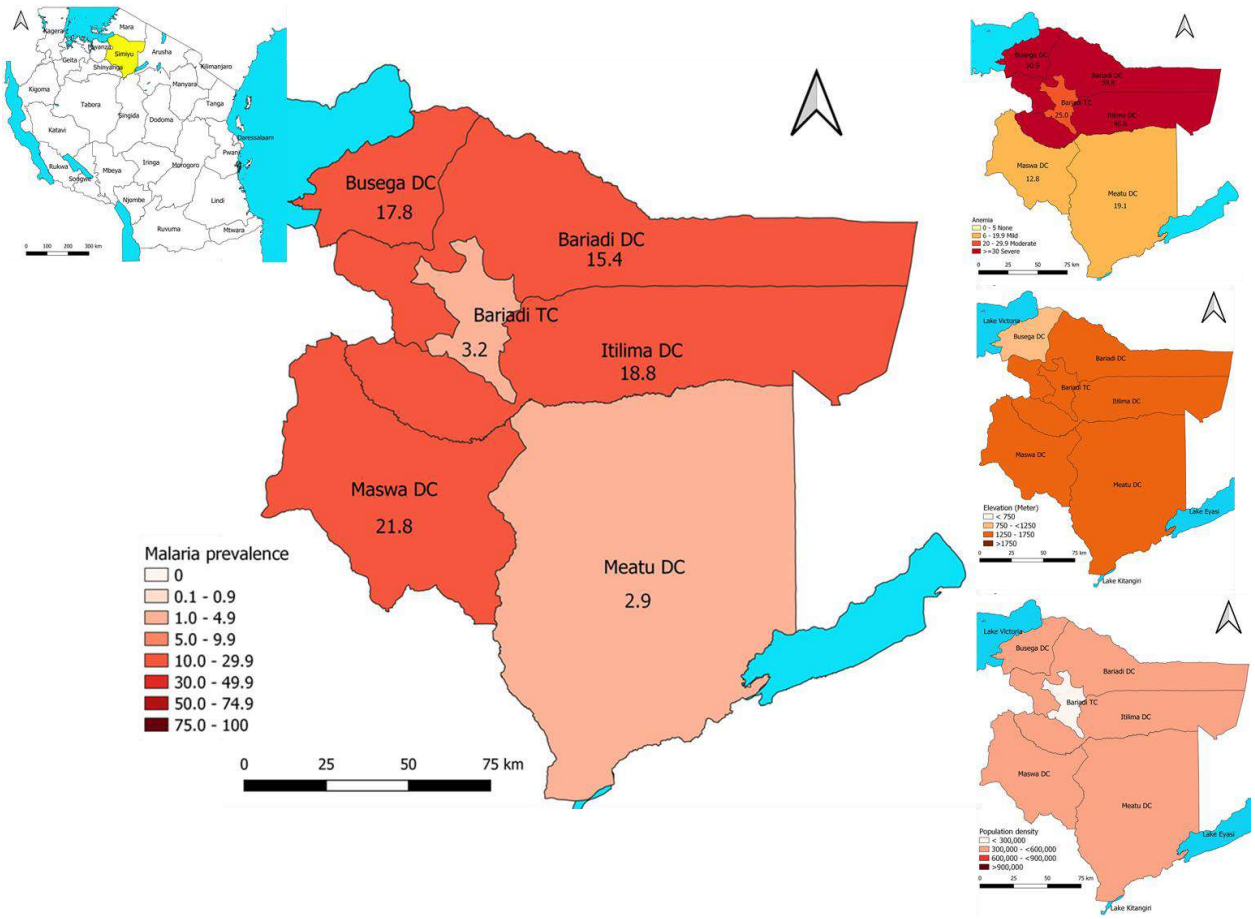
Appendix 20: The 2021 SMNS Regional Profile – Ruvuma



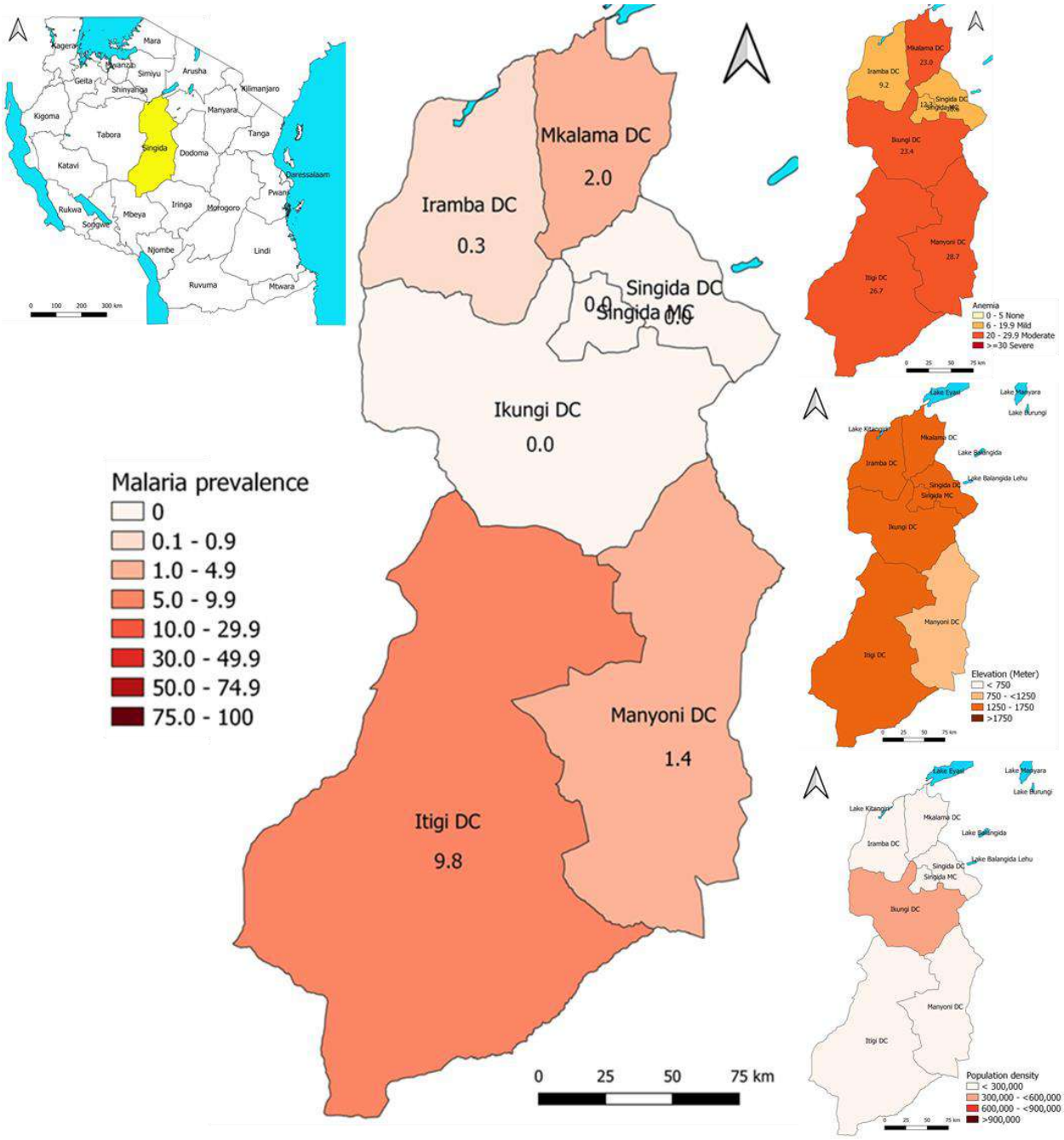
Appendix 21: The 2021 SMNS Regional Profile – Shinyanga



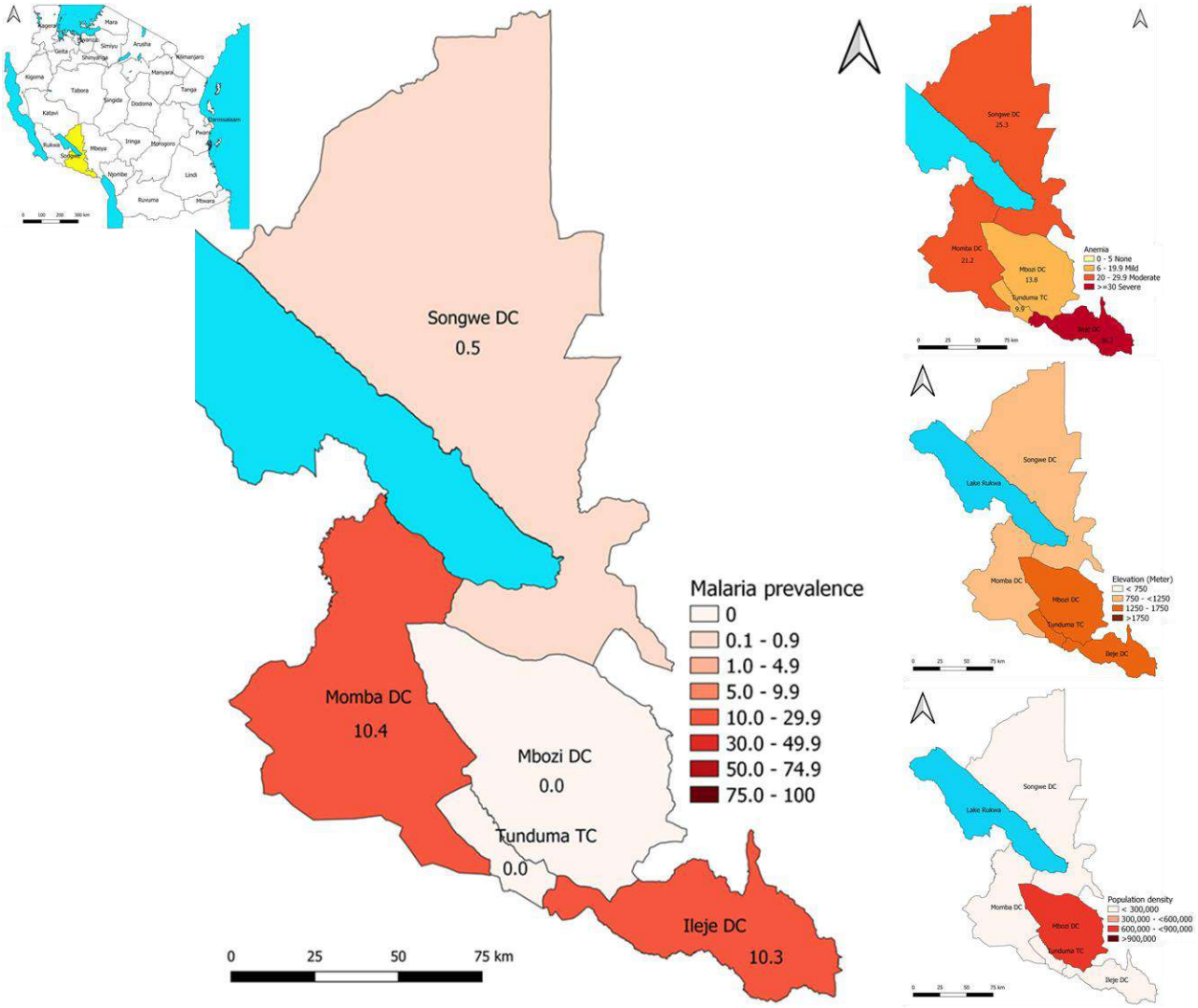
Appendix 22: The 2021 SMNS Regional Profile – Simiyu



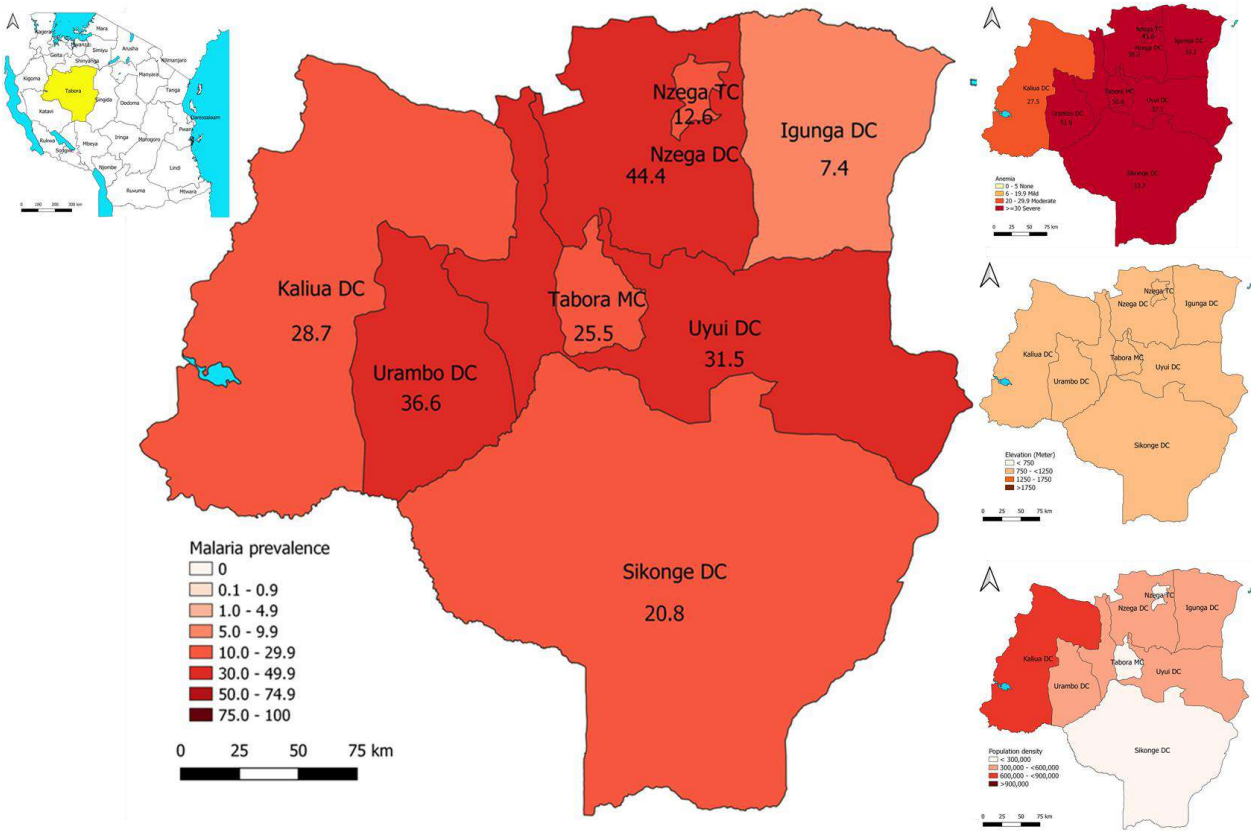
Appendix 23: The 2021 SMNS Regional Profile – Singida



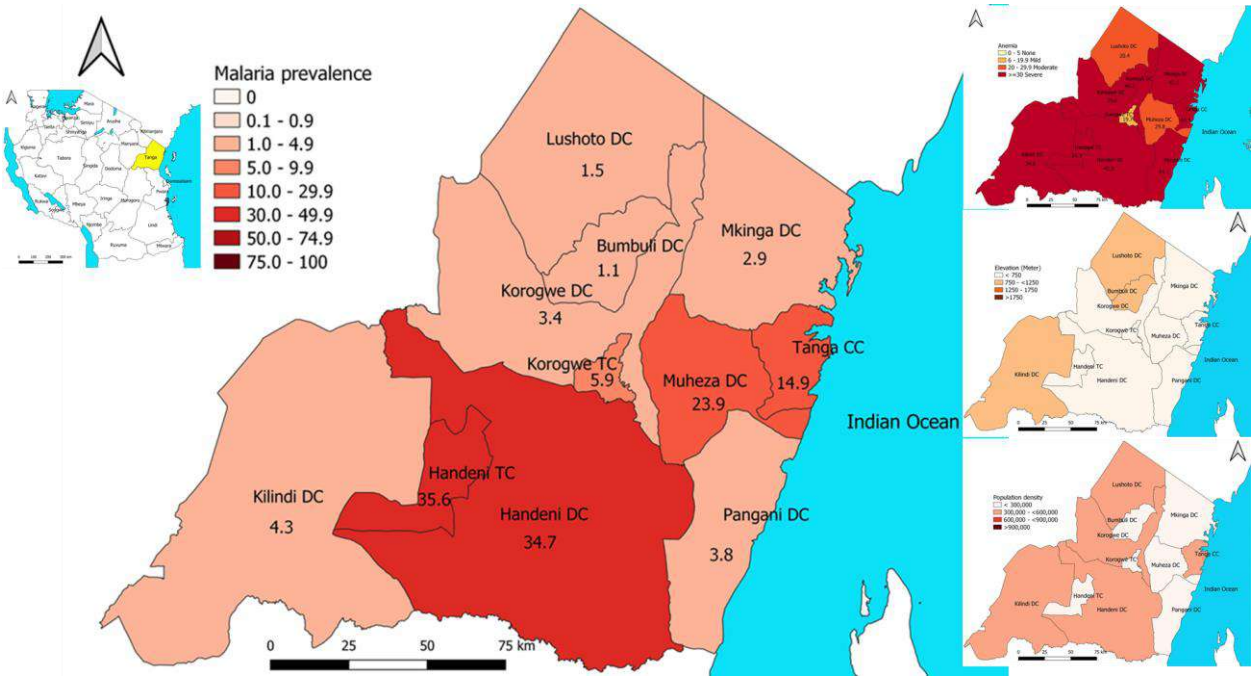
Appendix 24: The 2021 SMNS Regional Profile – Songwe



Appendix 25: The 2021 SMNS Regional Profile – Tabora



Appendix 26: The 2021 SMNS Regional Profile – Tanga



Distribution of public primary schools implementing SFP

Table 1-1: Distribution of public primary schools implementing SFP

BACKGROUND CHARACTERISTICS	SFP NOT AVAILABLE		SFP AVAILABLE		
	PERCENT	NUMBER OF SCHOOLS	PERCENT	NUMBER OF SCHOOLS	TOTAL SCHOOLS
Zones					
Central	59.7	46	40.3	31	77
Western	65.0	39	35.0	21	60
Southern	41.7	15	58.3	21	36
Southwest Highlands	66.7	42	33.3	21	63
Eastern	63.5	61	36.5	35	96
Southern Highland	26.3	15	73.7	42	57
Lake	66.2	104	33.8	53	157
Northern	20.7	19	79.3	73	92
Region					
Arusha	18.8	6	81.3	26	32
Dar es Salaam	64.4	29	35.6	16	45
Dodoma	82.8	24	17.2	5	29
Geita	65.2	15	34.8	8	23
Iringa	25.0	4	75.0	12	16
Kagera	50.0	16	50.0	16	32
Katavi	75.0	9	25.0	3	12
Kigoma	82.1	23	17.9	5	28
Kilimanjaro	6.7	2	93.3	28	30
Lindi	57.1	8	42.9	6	14
Manyara	31.0	9	69.0	20	29
Mara	67.9	19	32.1	9	28
Mbeya	61.9	13	38.1	8	21
Morogoro	67.7	21	32.3	10	31
Mtwara	31.8	7	68.2	15	22
Mwanza	61.1	22	38.9	14	36
Njombe	5.9	1	94.1	16	17
Pwani	55.0	11	45.0	9	20
Rukwa	82.4	14	17.6	3	17
Ruvuma	41.7	10	58.3	14	24
Shinyanga	78.9	15	21.1	4	19
Simiyu	89.5	17	10.5	2	19
Singida	68.4	13	31.6	6	19
Songwe	46.2	6	53.8	7	13
Tabora	50.0	16	50.0	16	32
Tanga	36.7	11	63.3	19	30
Council					
Arusha CC	12.5	1	87.5	7	8
Arusha DC	50.0	3	50	3	6

Babati DC	33.3	2	66.7	4	6
Babati TC	33.3	1	66.7	2	3
Bagamoyo	50.0	1	50.0	1	2
Bahi	100.0	2	0	0	2
Bariadi DC	100.0	3	0	0	3
Bariadi TC	100.0	2	0	0	2
Biharamulo	0	0	100.0	3	3
Buchosa DC	75.0	3	25.0	1	4
Buhigwe	33.3	1	66.7	2	3
Bukoba DC	0	0	100.0	4	4
Bukoba MC	100.0	3	0	0	3
Bukombe DC	100.0	3	0	0	3
Bumbuli	66.7	2	33.3	1	3
Bunda DC	25.0	1	75.0	3	4
Bunda TC	50.0	1	50.0	1	2
Busega	66.7	2	33.3	1	3
Busokelo	100.0	2	0	0	2
Butiama	100.0	3	0	0	3
Chalinze	66.7	2	33.3	1	3
Chamwino	100.0	6	0	0	6
Chato	60.0	3	40.0	2	5
Chemba	100.0	2	0	0	2
Chunya	100.0	2	0	0	2
Dodoma CC	66.7	4	33.3	2	6
Gairo DC	0	0	100.0	3	3
Geita DC	83.3	5	16.7	1	6
Geita TC	66.7	2	33.3	1	3
Hai	0	0	100.0	4	4
Hanang	60.0	3	40.0	2	5
Handeni DC	0	0	100.0	4	4
Handeni TC	0	0	100.0	2	2
Ifakara TC	100.0	1	0	0	1
Igunga	40.0	2	60.0	3	5
Ikungi	100.0	2	0	0	2
Ilala	60.0	9	40.0	6	15
Ileje	66.7	2	33.3	1	3
Ilemela	50.0	2	50.0	2	4
Iramba	0	0	100.0	4	4
Iringa DC	0	0	100.0	4	4
Iringa MC	0	0	100.0	3	3
Itigi	100.0	1	0	0	1
Itilima	75.0	3	25.0	1	4
Kahama TC	100	3	0	0	3
Kakonko	0	0	100.0	2	2
Kalambo	33.3	1	66.7	2	3
Kaliua	100.0	5	0	0	5

Karagwe	0	0	100.0	4	4
Karatu	0	0	100.0	4	4
Kasulu DC	100.0	5	0	0	5
Kasulu TC	66.7	2	33.3	1	3
Kibaha DC	50.0	1	50.0	1	2
Kibaha TC	0	0	100.0	2	2
Kibiti	50.0	1	50.0	1	2
Kibondo	100.0	4	0	0	4
Kigamboni	0	0	100.0	1	1
Kigoma MC	100.0	3	0	0	3
Kigoma Rural	100.0	3	0	0	3
Kilindi	0	0	100.0	3	3
Kilolo	33.3	1	66.7	2	3
Kilombero DC	100.0	4	0	0	4
Kilosa DC	83.3	5	16.7	1	6
Kilwa	100	2	0	0	2
Kinondoni	50.0	6	50.0	6	12
Kisarawe	100.0	2	0	0	2
Kishapu DC	100.0	4	0	0	4
Kiteto	40.0	2	60.0	3	5
Kondoa DC	100.0	3	0	0	3
Kondoa TC	50.0	1	50.0	1	2
Kongwa	50.0	2	50.0	2	4
Korogwe DC	100.0	3	0	0	3
Korogwe TC	0	0	100.0	2	2
Kwimba DC	40.0	2	60.0	3	5
Kyela	100.0	3	0	0	3
Kyerwa	100.0	3	0	0	3
Lindi Urban	100.0	2	0	0	2
Liwale	100.0	2	0	0	2
Longido	0	0	100.0	3	3
Ludewa	0	0	100.0	3	3
Lushoto	0	0	100.0	3	3
Madaba	0	0	100.0	2	2
Mafia	50.0	1	50.0	1	2
Mafinga TC	0	0	100.0	2	2
Magu DC	100.0	3	0	0	3
Makambako TC	0	0	100.0	3	3
Makete	0	0	100.0	3	3
Malinyi	50.0	1	50.0	1	2
Manyoni	100.0	3	0	0	3
Masasi DC	50.0	2	50.0	2	4
Masasi TC	0	0	100.0	2	2
Maswa DC	100.0	4	0	0	4
Mbarali	33.3	1	66.7	2	3
Mbeya CC	60.0	3	40.0	2	5

Mbeya DC	66.7	2	33.3	1	3
Mbinga DC	0	0	100.0	3	3
Mbinga TC	0	0	100.0	2	2
Mbogwe	66.7	2	33.3	1	3
Mbozi	0	0	100.0	4	4
Mbulu DC	0	0	100.0	4	4
Mbulu TC	33.3	1	66.7	2	3
Meatu	100.0	3	0	0	3
Meru	0	0	100.0	5	5
Missenyi	0	0	100.0	3	3
Missungwi	0	0	100.0	5	5
Mkalama	50.0	1	50.0	1	2
Mkinga	66.7	2	33.3	1	3
Mkuranga	33.3	1	66.7	2	3
Mlele DC	50.0	1	50.0	1	2
Momba	100.0	2	0	0	2
Monduli	0	0	100.0	3	3
Morogoro DC	75.0	3	25.0	1	4
Morogoro MC	100.0	5	0	0	5
Moshi DC	0	0	100.0	9	9
Moshi MC	0	0	100.0	3	3
Mpanda TC	100.0	2	0	0	2
Mpimbwe	0	0	100.0	2	2
Mpwapwa	100.0	4	0	0	4
Msalala DC	100.0	3	0	0	3
Mtama Rural	0	0	100.0	3	3
Mtwara Rural	0	0	100.0	2	2
Mtwara urban	50.0	1	50.0	1	2
Mufindi	75.0	3	25.0	1	4
Muheza	100.0	2	0	0	2
Muleba	75.0	6	25.0	2	8
Musoma DC	100.0	3	0	0	3
Musoma MC	66.7	2	33.3	1	3
Mvomero DC	66.7	2	33.3	1	3
Mwanga	33.3	1	66.7	2	3
Mwanza CC	75.0	6	25.0	2	8
Nachingwea	0	0	100.0	3	3
Namtumbo	100.0	3	0	0	3
Nanyamba	0	0	100.0	2	2
Nanyumbu	100.0	3	0	0	3
Newala DC	0	0	100.0	2	2
Newala TC	0	0	100.0	2	2
Ngara	100.0	4	0	0	4
Ngorongoro	66.7	2	33.3	1	3
Njombe DC	33.3	1	66.7	2	3
Njombe TC	0	0	100.0	2	2

Nkasi	100.0	4	0	0	4
Nsimbo	100.0	3	0	0	3
Nyang'hwale	0	0	100.0	3	3
Nyasa	100.0	3	0	0	3
Nzega DC	20.0	1	80.0	4	5
Nzega TC	0	0	100.0	2	2
Pangani	0	0	100.0	2	2
Rombo	0	0	100.0	4	4
Rorya	75.0	3	25.0	1	4
Ruangwa	100.0	2	0	0	2
Rufiji	100.0	2	0	0	2
Rungwe	0	0	100.0	3	3
Same	20.0	1	80.0	4	5
Sengerema DC	66.7	2	33.3	1	3
Serengeti	50.0	2	50.0	2	4
Shinyanga DC	100.0	4	0	0	4
Shinyanga MC	0	0	100.0	3	3
Siha	0	0	100.0	2	2
Sikonge	0	0	100.0	3	3
Simanjiro	0	0	100.0	3	3
Singida DC	100.0	4	0	0	4
Singida MC	66.7	2	33.3	1	3
Songea Rural	66.7	2	33.3	1	3
Songea Urban	0	0	100.0	4	4
Songwe DC	100.0	2	0	0	2
Sumbawanga DC	100.0	6	0	0	6
Sumbawanga MC	75.0	3	25.0	1	4
Tabora MC	66.7	2	33.3	1	3
Tandahimba	33.3	1	66.7	2	3
Tanga CC	66.7	2	33.3	1	3
Tanganyika	100.0	3	0	0	3
Tarime DC	66.7	2	33.3	1	3
Tarime TC	100.0	2	0	0	2
Temeke	57.1	4	42.9	3	7
Tunduma TC	0	0	100.0	2	2
Tunduru	50.0	2	50.0	2	4
Ubungo	100.0	10	0	0	10
Ukerewe DC	100.0	4	0	0	4
Ulanga DC	0	0	100.0	3	3
Urambo	0	0	100.0	3	3
Ushetu DC	50.0	1	50.0	1	2
Uvinza	100.0	5	0	0	5
Uyui	100.0	6	0	0	6
Wang'ing'ombe	0	0	100.0	3	3
Total	53.4	341	46.6	297	638

Table 1-2: Beneficiary amongst schools reported to provide school meals-

BENEFICIARIES	SOME CLASSES		ALL CLASSES		SCOOL-AGED CHILDREN (SAC) WITH SPECIAL NEEDS		TOTAL NUMBER OF SCHOOLS
BACKGROUND CHARACTERISTICS	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	
Zones							
Central	31.0	9	69.0	20	0	0	29
Western	14.3	3	85.7	18	0	0	21
Southern	0	0	100.0	20	0	0	20
Southwest Highlands	4.8	1	95.2	20	0	0	21
Eastern	18.8	6	75.0	24	6.3	2	32
Southern Highland	12.2	5	87.8	36	0	0	41
Lake	14.3	6	78.6	33	7.1	3	42
Northern	8.3	6	91.7	66	0	0	72
Total	12.9	36	85.3	237	1.8	5	278
Region							
Arusha	7.7	2	92.3	24	0	0	26
Dar es Salaam	46.2	6	46.2	6	7.7	1	13
Dodoma	20.0	1	80.0	4	0	0	5
Geita	0	0	100.0	6	0	0	6
Iringa	9.1	1	90.9	10	0	0	11
Kagera	0	0	100.0	12	0	0	12
Katavi	0	0	100.0	3	0	0	3
Kigoma	40.0	2	60.0	3	0	0	5
Kilimanjaro	10.7	3	89.3	25	0	0	28
Lindi	0	0	100.0	6	0	0	6
Manyara	25.0	5	75.0	15	0	0	20
Mara	22.2	2	66.7	6	11.1	1	9

Mbeya	0	0	100.0	8	0	0	8
Morogoro	0	0	100.0	10	0	0	10
Mtwara	0	0	100.0	14	0	0	14
Mwanza	20.0	2	60.0	6	20	2	10
Njombe	0	0	100.0	16	0	0	16
Pwani	0	0	88.9	8	11.1	1	9
Rukwa	33.3	1	66.7	2	0	0	3
Ruvuma	28.6	4	71.4	10	0	0	14
Shinyanga	25.0	1	75.0	3	0	0	4
Simiyu	100.0	1	0	0	0	0	1
Singida	75.0	3	25.0	1	0	0	4
Songwe	0	0	100.0	7	0	0	7
Tabora	6.3	1	93.8	15	0	0	16
Tanga	5.6	1	94.4	17	0	0	18
Total	12.9	36	85.3	237	1.8	5	278
Council							
Arusha CC	0	0	1000	7	0	0	7
Arusha DC	33.3	1	66.7	2	0	0	3
Babati DC	0	0	100.0	4	0	0	4
Babati TC	0	0	100.0	2	0	0	2
Bagamoyo	0	0	100.0	1	0	0	1
Biharamulo	0	0	100.0	1	0	0	1
Buchosa DC	0	0	100.0	1	0	0	1
Buhigwe	50.0	1	50.0	1	0	0	2
Bukoba DC	0	0	100.0	4	0	0	4
Bumbuli	0	0	100.0	1	0	0	1
Bunda DC	0	0	100.0	3	0	0	3
Bunda TC	100.0	1	0	0	0	0	1
Chalinze	0	0	100.0	1	0	0	1
Chato	0	0	100.0	2	0	0	2

Dodoma CC	50.0	1	50.0	1	0	0	2
Gairo DC	0	0	100.0	3	0	0	3
Geita DC	0	0	100.0	1	0	0	1
Geita TC	0	0	100.0	1	0	0	1
Hai	0	0	100.0	4	0	0	4
Hanang	0	0	100.0	2	0	0	2
Handeni DC	0	0	100.0	4	0	0	4
Handeni TC	0	0	100.0	2	0	0	2
Igunga	0	0	100.0	3	0	0	3
Ilala	66.7	4	33.3	2	0	0	6
Ileje	0	0	100.0	1	0	0	1
Ilemela	0	0	0	0	100.0	2	2
Iramba	50.0	1	50.0	1	0	0	2
Iringa DC	0	0	100.0	3	0	0	3
Iringa MC	0	0	100.0	3	0	0	3
Itilima	100.0	1	0	0	0	0	1
Kakonko	0	0	100.0	2	0	0	2
Kalambo	50.0	1	50.0	1	0	0	2
Karagwe	0	0	100.0	3	0	0	3
Karatu	25.0	1	75.0	3	0	0	4
Kasulu TC	100.0	1	0	0	0	0	1
Kibaha DC	0	0	100.0	1	0	0	1
Kibaha TC	0	0	100.0	2	0	0	2
Kibiti	0	0	100.0	1	0	0	1
Kigamboni	0	0	100.0	1	0	0	1
Kilindi	0	0	100.0	3	0	0	3
Kilolo	50.0	1	50.0	1	0	0	2
Kilosa DC	0	0	100.0	1	0	0	1
Kinondoni	0	0	66.7	2	33.3	1	3
Kiteto	0	0	100.0	3	0	0	3

Kondoa TC	0	0	100.0	1	0	0	1
Kongwa	0	0	100.0	2	0	0	2
Korogwe TC	0	0	100.0	2	0	0	2
Kwimba DC	50.0	1	50.0	1	0	0	2
Longido	0	0	100.0	3	0	0	3
Ludewa	0	0	100.0	3	0	0	3
Lushoto	0	0	100.0	3	0	0	3
Madaba	50.0	1	50.0	1	0	0	2
Mafia	0	0	0	0	100.0	1	1
Mafinga TC	0	0	100.0	2	0	0	2
Makambako TC	0	0	100.0	3	0	0	3
Makete	0	0	100.0	3	0	0	3
Malinyi	0	0	100.0	1	0	0	1
Masasi DC	0	0	100.0	2	0	0	2
Masasi TC	0	0	100.0	2	0	0	2
Mbarali	0	0	100.0	2	0	0	2
Mbeya CC	0	0	100.0	2	0	0	2
Mbeya DC	0	0	100.0	1	0	0	1
Mbinga DC	0	0	100.0	3	0	0	3
Mbinga TC	0	0	100.0	2	0	0	2
Mbogwe	0	0	100.0	1	0	0	1
Mbozi	0	0	100.0	4	0	0	4
Mbulu DC	100.0	4	0	0	0	0	4
Mbulu TC	50.0	1	50.0	1	0	0	2
Meru	0	0	100.0	5	0	0	5
Missenyi	0	0	100.0	3	0	0	3
Missungwi	0	0	100.0	3	0	0	3
Mkalama	100.0	1	0	0	0	0	1
Mkinga	100.0	1	0	0	0	0	1
Mkuranga	0	0	100.0	2	0	0	2

Mlele DC	0	0	100.0	1	0	0	1
Monduli	0	0	100.0	3	0	0	3
Morogoro DC	0	0	100.0	1	0	0	1
Moshi DC	0	0	100.0	9	0	0	9
Moshi MC	0	0	100.0	3	0	0	3
Mpimbwe	0	0	100.0	2	0	0	2
Mtama Rural	0	0	100.0	3	0	0	3
Mtwara Rural	0	0	100.0	2	0	0	2
Mtwara urban	0	0	100.0	1	0	0	1
Mufindi	0	0	100.0	1	0	0	1
Muleba	0	0	100.0	1	0	0	1
Musoma MC	0	0	0	0	100.0	1	1
Mvomero DC	0	0	100.0	1	0	0	1
Mwanga	0	0	100.0	2	0	0	2
Mwanza CC	100.0	1	0	0	0	0	1
Nachingwea	0	0	100.0	3	0	0	3
Nanyamba	0	0	100.0	1	0	0	1
Newala DC	0	0	100.0	2	0	0	2
Newala TC	0	0	100.0	2	0	0	2
Ngorongoro	0	0	100.0	1	0	0	1
Njombe DC	0	0	100.0	2	0	0	2
Njombe TC	0	0	100.0	2	0	0	2
Nyang'hwale	0	0	100.0	1	0	0	1
Nzega DC	0	0	100.0	4	0	0	4
Nzega TC	0	0	100.0	2	0	0	2
Pangani	0	0	100.0	1	0	0	1
Rombo	0	0	100.0	4	0	0	4
Rorya	100.0	1	0	0	0	0	1
Rungwe	0	0	100.0	3	0	0	3
Same	75.0	3	25.0	1	0	0	4

Sengerema DC	0	0	100.0	1	0	0	1
Serengeti	0	0	100.0	2	0	0	2
Shinyanga MC	33.3	1	66.7	2	0	0	3
Siha	0	0	100.0	2	0	0	2
Sikonge	0	0	100.0	3	0	0	3
Simanjiro	0	0	100.0	3	0	0	3
Singida MC	100.0	1	0	0	0	0	1
Songea Rural	100.0	1	0	0	0	0	1
Songea Urban	50.0	2	50.0	2	0	0	4
Sumbawanga MC	0	0	100.0	1	0	0	1
Tabora MC	100.0	1	0	0	0	0	1
Tandahimba	0	0	100.0	2	0	0	2
Tanga CC	0	0	100.0	1	0	0	1
Tarime DC	0	0	100.0	1	0	0	1
Temeke	66.7	2	33.3	1	0	0	3
Tunduma TC	0	0	100.0	2	0	0	2
Tunduru	0	0	100.0	2	0	0	2
Ulanga DC	0	0	100.0	3	0	0	3
Urambo	0	0	100.0	3	0	0	3
Ushetu DC	0	0	100.0	1	0	0	1
Wang'ing'ombe	0	0	100.0	3	0	0	3
Total	12.9	36	85.3	237	1.8	5	278

Annexes

Annex 1. Fact Sheet

Information Fact Sheet (English Version): School Committee, Teachers, Parents/Guardians

Introduction

We are staff from the ---------- Council and the Ministry of Health through the National Malaria Control Programme (NMCP) and Tanzania Food and Nutrition Centre (TFNC). We are conducting research amongst public primary school-aged children (SAC) aged 5–16 years on the prevalence of malaria, nutritional indices and the use of insecticide-treated mosquito nets. As members of school committees, teachers and parents/guardians of these children, we need your co-operation and permission to conduct the survey.

What is NMCP/TFNC research?

The NMCP/TFNC unit is a government institution within the Ministry of Health, (MoH) in Tanzania, which is responsible for the control of malaria and nutritional status of individuals by deploying various interventions, in collaboration with implementing partners. This usually involves investigating the health of individuals and groups, especially those persons who are more susceptible to a disease/problem. This is the type of research we are here to do today.

What is this research about?

In this research study, we want to learn more about the occurrence of malaria, establish baseline information for nutrition indices and determine the use of mosquito nets among SAC in Mainland Tanzania. Additionally, the information we collect will be able to provide information on the linkage of malaria, anaemia and malnutrition, which is necessary to understand for successful redesign of related interventions, implementation and programme scale-up across schools in Tanzania.

What will it involve for my child(ren)?

We will take a small sample of blood from your child(ren) to determine if they have malaria parasites and their haemoglobin (Hb) level. We will take another blood sample for further analysis to guide programmes and realign malaria control strategies. We will use a sterile needle to make a prick on a finger and collect a small blood sample, which will be less than half a teaspoon (2ml). Additionally, each child's weight and temperature will be obtained to assess determinants of malaria infection and guide provision of correct malaria drug dosage (in case a child is found to have malaria parasites).

Are there any disadvantages involved in taking part?

There are minimal risks with participating in this study. The finger prick for the blood samples may cause minor, temporary discomfort for children.

Are there any benefits to me/my child(ren) in taking part?

Children who are found to be infected with malaria will be provided, free of charge, appropriate treatment, as instructed in the National Diagnostic and Treatment Guidelines. The drugs used for treatment are artemisinin-based combination therapies (ACTs) and are known to be safe in most people; they are commonly used in Tanzania. ACTs are the government-recommended treatment for malaria. Additionally, children will be provided with health education toward a proper diet. Children found to have low Hb will be referred to healthcare facility. The information generated from the survey will be very useful for making decisions about parasite control in your community and in our country.

What will happen if I don't agree to participate?

All participation in this research is voluntary. You are free to decide if you want your child(ren) to take part or not. If you do agree, you can change your mind at any time and withdraw your child from the research study. This will not affect their care now or in the future.

What happens to the samples?

Most of the tests that are needed as part of this research study will be done locally in Tanzania. If the capacity to conduct advanced analysis is unavailable in the country, a special request will be submitted to the National Institute for Medical Research for a material transfer agreement.

Who will have access to information about me/my child(ren) in this research?

We will take strict precautions to safeguard your child's personal information throughout the study. All our research records are stored securely in locked cabinets and password-protected computers. Only a few people who are closely connected with the research will be able to view information about participants, including those involved in the data analysis.

Who has allowed this research to take place?

All research at the NMCP is approved by a national independent expert of the Medical Research Coordinating Committees in Dar es Salaam, who makes sure the research is conducted properly and that participants' safety and rights are respected.

Methods

This study will be coordinated by the NMCP in collaboration with the local authorities and partner institutions. A representative sample of approximately 847 public primary schools have been selected in all 184 councils and 26 regions in Mainland Tanzania.

This study was reviewed by the National Institute for Medical Research (NIMR) under the National Health Research Ethics Committee NatHREC, and has been approved under number **NIMR/HQ/R.8c/Vol.I/1857**. School head teachers will be informed beforehand of the survey, and head teachers will brief the parents, children and staff on the purpose of the survey and collect their consent.

In each school, a random sample of an average of 100 children will be selected from the age group of 5–16 years. The following information will be collected from each child:

- Age/date of birth, use of insecticide-treated nets by themselves and others in their household, school absenteeism history and presence of a febrile illness in 2 weeks before the survey. This will involve the use of a questionnaire.
- Presence of malaria infection based on a single finger prick blood sample using a malaria rapid diagnostic test (RDT).
- On-site treatment with the nationally recommended age-specific drug dosing regimen will be given to children who test positive for malaria.

What if I have questions?

You may ask any of our staff questions at any time. You can also contact those who are responsible for the care of your child and this research study as follows**: Frank Chacky,** NMCP P.O. Box 743, Dodoma; Telephone +255 754 625 131

If you have questions about your rights as a study participant, concerns about the research or if you want to ask someone independent of the study about this research, please contact: **The Chair MRCC**, P.O. Box 9653, Dar es Salaam; Telephone: +255 222 121 400.

Information Fact Sheet (Swahili Version): School Committee, Teachers, Parents/Guardians

Taarifa muhimu ya Utafiti kwa kamati ya Shule, walimu na mzazi/mlezi

Utangulizi

Sisi ni wafanyakazi wa halmashauri ya _____ na Wizara ya Afya kupitia Mpango wa Taifa wa Kudhibiti Malaria na Taasisi ya Chakula na Lishe. Tunafanya utafiti kwa watoto wa shule za msingi za serikali ili kutambua kiwango cha maambukizi ya vimelea vya malaria, wingi wa damu, hali ya lishe na matumizi ya vyandarua vilivyowekewa dawa kwa ajili ya kujikinga na malaria. Kama kamati ya shule, walimu, wazazi na walezi wa wanafunzi watakaoshiriki katika utafiti; tunaomba ushirikiano wenu wa dhati ikiwa ni pamoja na kuwaruhusu watoto wenu kufanyiwa utafiti.

Nini maana ya Utafiti?

Mpango wa taifa wa Kudhibiti malaria (NMCP) ni taasisi ya serikali ndani ya wizara ya Afya na Maendeleo ya Jamii, Jinsia, Wazee, na Watoto ikiwa na majukumu ya kuhakikisha inadhibiti malaria nchini. Pia NMCP inasimamia kazi zilizokusudiwa kufanywa na wadau ili kuhakikisha malaengo yaliyokusudiwa yanafikiwa. Hii ni pamoja na kufanya tafiti mbalimbali kwa kila mmoja na makundi pia ambayo malaria imeonesha kuwa tatizo zaidi. Utafiti huu ni mojawapo wa shughuli zinazofanywa na programu ya malaria.

Utafiti huu unahusu nini?

Katika utafiti huu, NMCP inataka kujua zaidi jinsi ugonjwa wa malaria unavyotokea na matumizi ya vyandarua vilivyotiwa dawa ya viuatilifu kwa watoto wa shule za msingi katika mikoa iliyochaguliwa. Pia, utafiti huu utahusisha kufahamu hali ya chakula na lishe kwa wanafunzi na kutambua kiwango cha damu. Utafiti huu utawahusu watoto wa shule za msingi zilizochaguliwa katika mikoa yote 26 ya Tanzania Bara na katika kila shule kwa kutumia njia ya nasibu wastani wa watoto 100 wanatarajiwa kuchaguliwa.

Ni vitu gani vitakavyohiusiana na mtoto/watoto wako?

Watafiti watakuwa wanachukua sampuli kidogo ya damu kwa ajili ya kuipima ili kuangalia kama ina maambukizi ya vimelea vya malaria na kujua kiwango cha damu. Aidha, sindano zilizotakaswa zitatumika kutoa sampuli ya damu katika kidole na kisha kiasi kidogo cha sampuli ya damu kitachukuliwa kama mililita 2 hivi. Sampuli ya damu itakayochukuliwa itatumika kupima uwepo wa vimelea vya malaria kwa kutumia kipimo cha kutambua malaria kwa haraka yaani kwa kimombo “Rapid Diagnostic Tests” (RDT). Kiasi kidogo cha damu kitawekwa kwenye karatasi maalum na kitatumika kufanya uchambuzi kubaini kama vimelea vya malaria vilivyoko kwenye enoe lako vimeota usugu dhidi ya dawa za kutibu ugonkwa wa malaria na hali ya maambuzi ya ugonjwa wa malaria. Kiasi kidogo cha sampuli ya damu itatumika kupima kiwango cha damu kwa kila mtoto. Pia wanafunzi watakaochaguliwa wataulizwa maswali yanayohusiana na matumizi ya vyandarua majumbani na hali ya lishe na chakula kwa kutumia dodoso maalumu Ridhaa itaombwa kabla ya uulizwaji wa maswali.

Je, kuna madhara yoyote yanayopatikana kama mwanao/wanao watashiriki katika utafiti huu?

Hakuna madhara yatokanayo na kushiriki katika utafiti huu. Isipokuwa, kuna maudhi madogo madogo yanayoweza kutokea hasa wakati wa kutobolewa ili kuchukua sampuli ya damu ambayo yanachukua muda mfupi na kisha kutoweka.

Ni faida zipi mwanao/wanao watazipata iwapo watashiriki katika utafiti huu?

Mtoto yeyote ambae atagundulika ana vimelea vya malaria watapatiwa matibabu bure, kulingana na mwongozo uliopo wa kitaifa wa kutibu malaria. Aidha, dawa zitakazotumika katika utafiti huu zinajulikana nchini na ni salama kabisa. Pia hizi dawa zimeidhinishwa na serikali kwa ajili ya matibabu ya malaria; ambayo ni dawa mseto ya malaria. Pia, elimu ya chakula bora itatolewa. Taarifa itakayopatikana kutokana na utafiti huu ni muhimu sana katika kuiwezesha programu ya malaria kufanya maamuzi juu ya udhibiti wa malaria katika jamii zetu na Taifa kwa ujumla.

Ni nini kitatokea kama sintaruhusu mwanangu/wanangu kushiriki katika utafiti huu?

Ushiriki katika utafiti huu ni wa hiari. Uko huru kuamua endapo mwanao/wanao washiriki katika utafiti huu au la. Endapo utakubali kumruhusu mwanao/wanao kushiriki katika utafiti huu, unaweza kubadilisha mawazo na kumzuia/kuwazuia wasiendelee na utafiti. Yote haya hayatakuwa na madhara yoyote ya baadae kwa mwanao/wanao.

Ni kitu gani kinachofanyika kwenye sampuli ya damu itakayochukuliwa?

Baada ya sampuli ya damu kuchukuliwa, kipimo kitafanyika katika eneo husika na majibu kutolewa papo hapo. Pia hii itawezesha kuwapatia matibabu watoto ambao watagundulika wana malaria mara moja. Kama utatoa idhini kwa mwanao kushiriki, sampuli zitakazochukuwa zitafanyiwa vipimo zaidi vitakavyofanyika kwenye maabara zilizopo nchini au kama itahitajika uchambuzi wa ziada wa kitaalamu nje ya nchi; kibali maalumu kitaombwa katika taasisi ya Utafiti wa Magonjwa ya Binadamu (NIMR).

Ni nani mwenye haki ya kuona taarifa za utafiti huu?

Tahadhari kubwa imechukuliwa kuhakikisha taarifa za mwanao/wanao hazifikiwi kirahisi na mtu yeyote. Hii ni pamoja na kuhakikisha taarifa imehifadhiwa kwa siri ikiwa ni pamoja na kutumia funguo kwenye makabati yatakayoifadhia fomu za maswali yatakayotumika kuhoji wanafunzi na kuweka namba za siri kwenye kompyuta zitazotumika kuzihifadhi taarifa. Watu wachache tu wataruhisiwa kuona taarifa hizi za utafiti ikiwa ni pamoja na watakaoshiriki katika uchambuzi wa takwimu zikusanywazo na utafiti huu.

Ni nani ameruhusu utafiti huu kufanyika?

Tafiti zote zinazofanywa na program ya malaria (NMCP) zinaidhinishwa na bodi maalumu ya utafiti wa magonjwa ya binadamu iliyoko Dar es Salaam ikiwa na lengo la kuhakikisha utafiti unafanyika kwa usahihi na haki na usalama wa mshiriki unazingatiwa.

Inakuwaje kama nitakuwa na maswali?

Unaweza kumwuliza mmojawapo wa mtafiti wakati wowote. Unaweza kuwasiliana na mhusika moja kwa moja na utafiti huu: Frank Chacky – NMCP, S.L.P 743, odoma. Simu na. +255 754 625 131.

Kama utakuwa na maswali juu ya haki uliyonayo kama mzazi wa mshiriki, au juu ya utafiti huu, au maswali mengineyo ambayo hayahusiani na utafiti huu, tafadhali wasilina na: Mwenyekiti, Tume ya Utafiti wa Magonjwa ya binadamu (“MRCC”), S.L.P. Box 9653 Dar es Salaam, Simu na.: +25522 2121400.

Annex 2: Protocol for malaria testing, quality assurance and control

Malaria rapid diagnostic testing (mRDT), haemoglobin (Hb) and preparation of dried blood spot (DBS) for primary school-aged children (SAC) during the School Malaria Parasitemia Survey (SMNS).

Quality Assurance and Quality Control Protocol

PREPARATION

Before leaving to go to the site where mRDT, Hb measurement and DBS preparation will take place, the tester should make sure that he/she has the following items:

9. mRDT

- Enough mRDT kits
- Waste disposal containers (e.g. sharp box, infectious waste container and non-infectious waste container)
- Laboratory coat/apron
- Clean examination gloves
- 0.1% sodium hypochlorite solution or commercial Jik
- mRDT register
- mRDT standard operating procedures SOP
- mRDT job aide
- Ball pen/markers
- Wall clock

10. Hb measurement

- HemoCue machine 201+
- HemoCue cuvettes 201+
- Cotton wool (dry swabs)
- Hb register
- Dry cells (finger batteries)

11. DBS

- Sized filter papers
- Re-sealable storage bags plastic bags
- Desiccants

TESTING SITE

Upon arrival at the site, the tester should seek a room where the testing activity will take place. The room should be prepared as a temporary testing site and should have, at minimum, the following:

- Enough space
- Clean
- Well lit

- 1 flat table that will accommodate the undertaking of all testing procedures and registers
- 2 chairs
- An improvised washing place with clean running tap water (At least a bucket with tape)

TESTING PROCEDURES

The tester should organise the testing set up so that the registration of children takes place in the testing room, by the tester, before the child is pricked. Children should not be tested before they are registered.

The mRDT, Hb measurement and DBS preparation SOPs should be clearly displayed and strictly adhered to, and their job aides should be handy on the table all the time during testing for quick reference.

The tester should read the insert/leaflet in the mRDT test kit, paying particularly attention to the waiting time and the number of buffers drops to be added.

RECORDING OF RESULTS

mRDT

mRDT test results should be recorded on the device, SAC card and mRDT register. Record results as POSITIVE (POS) or NEGATIVE (NEG) on the SAC card. INVALID (INV) results should NOT be recorded on the SAC card. Invalid results should be recorded on the test device and mRDT register and the test MUST be repeated. If there are three consecutive invalid results from the same kit, the kit should be closed, reported to the supervisor and replaced by another kit. Record results of the test on the mRDT register in the result column by ticking the appropriate column(s) corresponding with appearance of lines on the test window and fill the interpretation column accordingly.

Hb

Record the number displayed on the screen of HemoCue machine on the appropriate form/register.

12. **mRDT Quality Assurance and Quality Control (mRDT QA/QC)**

To ensure quality testing and reliable test results the tester should strive to achieve the following minimum performance standards:

- Physical inspection: The tester should check the kit and its components for physical damage, evidence of water or chemical spills and expiry date. Check if kit accessories are all present (e.g. device, buffer, alcohol swabs, prickers and blood transfer device) any discrepancy should be reported to the site supervisor and a decision made on whether to use the kit or not should be made according to the extent of the discrepancies.
- Labelling of the device: All devices should be clearly labelled to show identification of the child (name and number), date of the test and start and end time.
- Blood volume: The correct amount of blood should be used and applied on the correct well of the device. The tester should use the blood transfer device that came with the

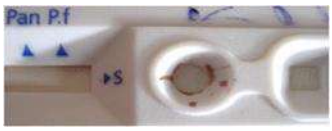
kit and use the correct technique to apply blood on the device. The tester should make sure that the device has no

- blood splatter
- Red colouration on the reading window at end time
- No blood clot on the sample well.

Any device with one or all three mentioned above is of a poor quality and the results are not reliable.

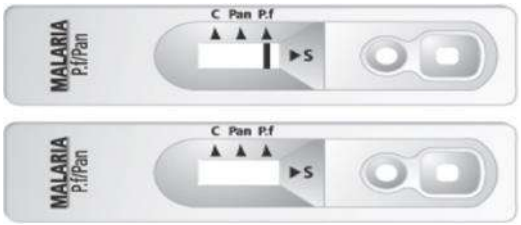
13. **Buffer**: The tester should use the correct number of drops on the correct buffer well on the device so that at the end of the test there is no blood clot on the sample well, reading window as well as red colouration, invalid result and back flow.
    - Devices with the above-mentioned conditions are of low quality and their results are not reliable.
14. **Timing:** The waiting time should be strictly adhered to. Test results should not be read before 15 minutes have elapsed. Negative results should be reported after the waiting time specified by the manufacturer has passed.
15. **Used mRDT devices**: Used mRDT devices should be quality checked by the supervisors at the end of the day. The supervisor will randomly select 10% of the used devices and inspect them for:

a) Labelled correctly



b) There is no blood splatter

c) The test window (reading window) does not have red colouration



d) Presence or absence of the control line

- Used mRDT devices should not be discarded and disposed of after the test. They should be kept in a box and transported to be stored at the regional headquarters for subsequent reference and monthly test checking by mRDT QA/QC supervisors. Such devices should be kept for a minimum of 1 month before they are disposed.

16. **Hb estimation**
    - Avoid touching the micro-cuvettes with your fingers
    - Make sure there are no air bubbles in the micro-cuvettes
    - Avoid using clotted blood

- Clean the HemoCue machine at intervals according to manufacturer's instructions

17. **DBS**

- **DON'T** use any paper other than the specified filter paper to prepare DBS
- Avoid smearing blood on the filter paper instead of using free dropping blood
- Dry the DBS in a dust-free environment at the same time avoiding insects and direct sunlight

DON'T *pack inadequately dried or wet DBS in a re-sealable storage bag*

Decayed DBS samples in comparison to a fresh sample at the centre bottom

NEVER pack more than one DBS in a re-sealable storage bag

18. **Safety precautions**

- **Personal protection**: A laboratory coat/apron, as well as clean examination gloves, should be worn during the procedure. Gloves should be changed when they are soiled (every 5–10 children).
- **Waste disposal**: There should be three clearly labelled waste containers, sharp box, infectious waste container and a non-infectious waste container.
- **All prickers (blood lancets), blood transfer devices and HemoCue cuvettes should be put into a sharp box immediately after they are used**. DO NOT put them on the table at any time. Used gloves and alcohol swabs should be discarded into the infectious containers. Device envelopes and desiccants should be put into the non-infectious container. When the waste containers are full, they should be transported to a nearby health facility where they should be disposed according to Infection Prevention and Control guidelines. DO NOT dispose mRDT and HemoCue waste on the school premises.

Annex 3: Malaria RDT standard operating procedures

Table 1-3: Malaria RDT Standard Operating Procedures

DIAGNOSIS OF MALARIA USING RAPID DIAGNOSTIC TEST (RDT)			
Purpose	This procedure provides instructions for diagnosing malaria using RDTs		
Materials	Reagents	Supplies	Equipment
	Buffer	Capillary tube/pipette/loop Lancet Alcohol prep pad Gloves Felt pen/marker pen	RDT device Clock/timer Sharps containers Infectious waste containers Non-infectious waste containers
Sample	Fresh whole blood		
Special safety precautions	All specimens should be considered as potentially infectious: Wear gloves during mRDT procedure Handle sharp instruments carefully Dispose all used deposable materials according to safety and waste management procedures Use new mRDT package and lancet for each patient		
Quality control	Make sure that the control line is reactive before interpretation of the results		

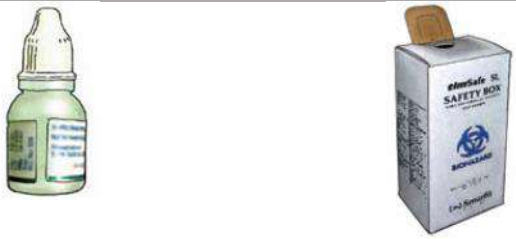
Follow the activities in the table below to

Step	Action	Procedure
1	Follow every step in the SOP.	
2	Prepare all the materials before performing mRDT test.	
3	Explain to the patient that you are going to test for malaria using mRDT.	
4	Open mRDT kit and check: • If the envelope is intact • Expiry date on the envelope and buffer • If the lot number on the kit matches with the buffer number • For the presence of capillary tube or pipette, alcohol pad and lancet.	
5	Open the RDT envelop carefully and check for the integrity of the cassette and desiccant. If using the loop system, check for the presence and integrity of the loop.	
6	Write patients unique identifier (dual identification) on the surface of the device.	
7	Put on/wear gloves.	
8	Clean the patient's finger with the alcohol pad/swab and leave it to dry. The finger must be dry before pricking.	
9	Prick the patients' finger to get the drop of blood.	
10	Collect the blood.	
	If	*Then*

	Loop	Use the tip of the loop to collect the required amount of blood according to manufacturer's instruction.
	Pipette	Use the pipette to collect the required amount of blood according to manufacturer's instruction.
	Capillary tube	Use the tip of capillary tube to touch the blood and wait until it reaches the recommended level.
11	Immediately touch the RDT well/hole with the instrument to drop the blood.	
12	Immediately put the recommended drops of buffer to the appropriate well/hole. Don't use the buffer from different kits or lots number.	
13	Immediately record the time and read the results 15 minutes for a negative test after adding buffer. Report a positive test as soon as the control line is visible. The devise can detect a positive test within a few minutes. Do not report a negative result before 15 minutes have elapsed or after 20 minutes.	
14	Interpret the results	
	If	*Then*
	Control band is not reactive and test band reactive	Invalid results – Repeat the test
	Control band is not reactive and test band not reactive	Invalid results – Repeat the test
	Control band is reactive	Valid results – continue with interpretation of the result
	Control band and test band is reactive	Positive test
	Control band reactive and test band not reactive	Negative results
15	Record results on the cassette, investigation form and on the lab register.	
16	Dispose of all infectious waste properly.	

Annex 4: Job aide to perform malaria rapid diagnostic test (mRDT)

Prepare needed materials



Perform the test

1

2

3

4

5

6

7

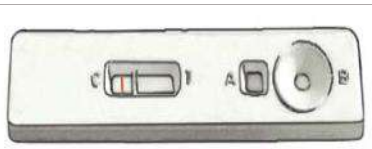
8

9

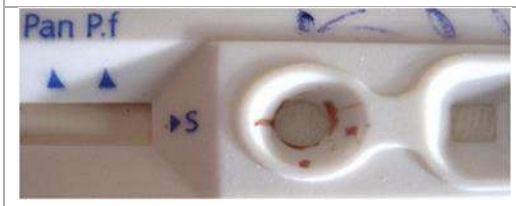
10

11

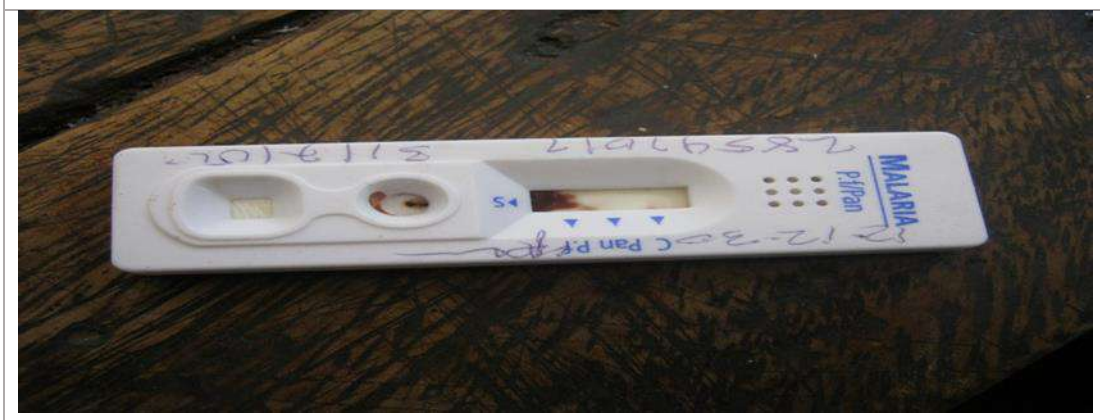
12



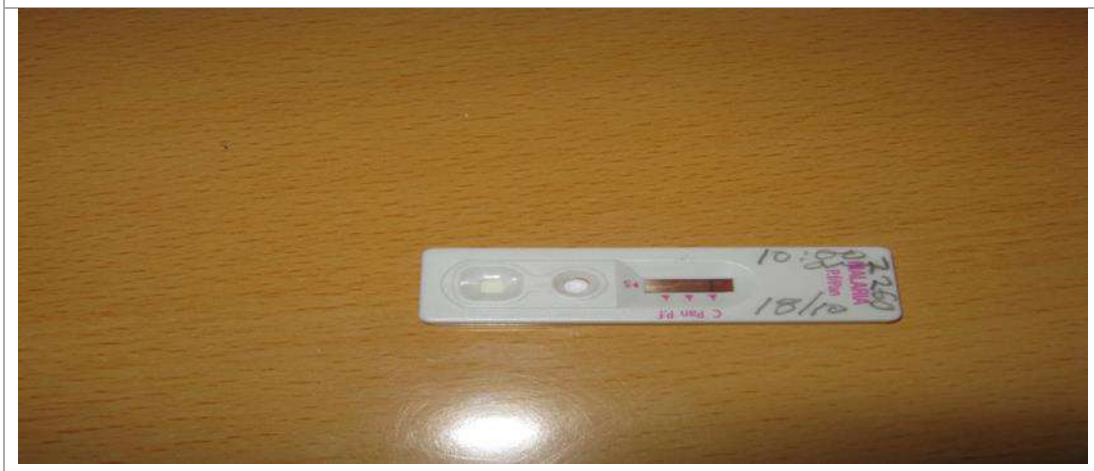
13 *14*



Blood deposited on the sides of sample well (blood splatter)



Blood clotted on sample well as well as reading window due to either insufficient buffer or delayed buffer addition



Red colouration on the reading window resulting from adding too much blood

Annex 4: Consent forms

Consent Form (English Version) – School Committee

Hello. My name is _____. On behalf of the National Malaria Control Programme (NMCP), we are conducting a survey about malaria infection, anaemia and nutrition status among primary school-aged children (SAC) in 26 regions of Tanzania. The information we collect will help the malaria programme to plan and evaluate its interventions. Children were selected for this survey after conducting probability sampling. The survey team will ask children some questions about the use of insecticide-treated bed nets at home and other related questions. We will also take blood samples from each child to test for malaria parasites and anaemia. This exercise usually takes about 15 to 20 minutes. All the answers that the children provide will be confidential and will not be shared with anyone other than members of our survey team.

Participation in this research is voluntary. The school committee is free to decide if it is willing to allow children to take part or not on behalf of the parents. If the committee agrees, it is also free to change its mind at any time and withdraw the children from the research study. This will not affect their care now or in the future. Also, a child can decide not to answer some of the questions by letting an interviewer know. The interviewer will go on to the next question.

As the committee representative do you have any questions so far?

May I begin interviewing the children now?

The school committee agree/disagree for the children to be interviewed *(circle relevant response)*.

NB: If the committee agrees, then the chairperson should sign below.

_____

Signature (Chairperson, School Committee)

<u>Fomu ya ridhaa</u> (Swahili Version) – Kamati ya Shule

Habari. Jina langu ni _____. Nafanya kazi/kwa niaba ya mpango wa Taifa wa Kudhibiti Malaria nchini – NMCP. Tunafanya utafiti juu ya ugonjwa wa malaria na upungufu wa damu kwa watoto wa shule za msingi wa mikoa 26 nchini. Ripoti itakayopatikana kutokana na utafiti huu itaiwezesha program ya malaria kupanga mikakati yake na kutathmini matokeo ya mikakati yake. Wanafunzi wamechaguliwa kwa nasibu. Wanafunzi wataulizwa maswali yanayohusiana na matumizi ya vyandarua vilivyotiwa viuatilifu majumbani pamoja na kuchukua sampuli ya damu kwa ajili ya kupima vimelea vya malaria na wingi wa damu. Zoezi hili litachukua taribani dakika 15 mpaka 20. Matokeo ya vipimo na majibu ya wanafunzi yatakuwa ya siri na hamna atakaeruhusiwa kuyafikia isipokuwa kwa walioshiriki katika utafiti huu.

Ushiriki katika utafiti huu ni wa hiari na kamati ya shule kwa niaba ya wazazi iko huru kuamua iwapo wanafunzi washiriki au la. Pia kama kamati ya shule ikiamua wanafunzi washiriki inaruhusiwa kubadilisha maamuzi na kujitoa katika utafiti huu. Hii haitaathiri wanafunzi kwa sasa wala kwa baadae. Aidha, mwanafunzi anaweza kuamua kutokujibu maswali yote atakayoulizwa; atakachofanya ni kumwambia muulizaji naye astaliruka hilo swali na kuendelea na mengine.

Kamati ya shule ina swali lolote mpaka sasa?

Je, naweza kuanza kuwahoji wanafunzi maswali na kuchukua sampuli ya damu kwa sasa?

KAMATI YA SHULE IMEKUBALI/IMEKATAA WANAFUNZI KUHOJIWA

Kama kamati ya shule imeridhia, Mwenyekiti ya Kamati aweke sahihi.

_____

Sahihi ya Mwenyekiti wa Kamati ya Shule.

Consent form –Head of Household (English version)

We are government officials from _____Council, working on behalf of the Ministry of Health, Community Development, Gender, Elderly and Children through the National Malaria Control Programme (NMCP). We are conducting a survey about malaria infection, the use of treated mosquito nets and anaemia among primary school-aged children (SAC) in 26 regions of Tanzania. Your household is among the houses that have been selected to participate in the short interview of this study. The interview will take approximate 20 minutes and will observe some areas in your household, including to checking the availability and use of mosquito nets. All responses will be confidential and will not be shared with anyone other than members of our survey team.

Participation in this research study is voluntary. You are free to decide if you are would like to take part or not, change your mind at any time and withdraw from the research or not answer questions that you don't want to answer. This will not affect any of services that you deserve. It is our hope that you will cooperate with us to help us obtain valuable information that will contribute to the control of malaria in Tanzania.

You may ask any of our staff questions at any time. You may also contact the Principal Investigator for this research: **Frank Chacky,** NMCP P.O. Box 743, Dodoma; Telephone +255 754 625 131.

If you have questions about your rights as a study participant, concerns about the research or if you want to ask someone independent anything about this research, please contact:

The Chair MRCC, P.O. Box 9653, Dar es Salaam; Telephone: +255 222 121 400.

HAS GIVEN CONSENT (Circle the correct answer)

YES = 1 NO = 2→→→

(1: START INTERVIEWING; 2: CLOSE THE INTERVIEW)

_____

SIGNATURE OF THE INTERVIEWEE

_____

THUMBPRINT OF THE INTERVIEWEE

_____

DATE

Fomu ya ridhaa (Kiswahili)

Sisi ni wafanyakazi wa Halmashauri ya _____. Tunawakilisha Wizara ya Afya, Maendeleo ya Jamii, Jinsia, Wazee, na Watoto kupitia Mpango wa Taifa wa Kudhibiti Malaria (NMCP) kuendesha utafiti kwa watoto wa shule za msingi za serikali ili kutambua kiwango cha maambukizi ya ugonjwa wa malaria, matumizi ya vyandarua vilivyowekwa dawa, upungufu wa damu na hali ya lishe. Kaya yako/yenu imechaguliwa kuwakilisha zile zinazoshiriki katika mahojiano mafupi yanayohusu utafiti huu. Mahojiano yatachukua takribani wastani wa dakika 20; na yatahusisha kuangalia baadhi ya maeneo ya nyumba yako ikiwa ni pamoja na uhakiki wa uwepo na matumizi ya vyandarua katika kaya. Majibu yote yatakayopatikana yatahifadhiwa kwa usiri na kutumika kwa lengo la kazi hii pekee.

Ushiriki katika zoezi hili ni wa hiari; hivyo una uamuzi wa kushiriki au kutoshiriki. Pia, unaweza kujitoa wakati wowote kuendelea na mahojiano hata kama umesharidhia kushiriki. Endapo utaamua kushiriki na baadae ukabadili mawazo, una hiari ya kujitoa na una maamuzi ya kutokujibu swali lolote ambalo hautapenda kujibu. Ila tuna imani utapenda kushirikiana nasi kwa ajili ya kupata mchango wako katika kuboresha shughuli za udhibiti wa ugonjwa wa malaria Tanzania.

Unaweza kuuliza mmojawapo wa watafiti wakati wowote. Pia, unaweza kuwasiliana na mhusika mkuu wa utafiti huu moja kwa moja: **Frank Chacky** – NMCP, S.L.P 743, Dodoma. Simu na. **+255 754 625 131.**

Kama utakuwa na maswali juu ya haki yako kama mshiriki juu ya utafiti huu, au maswali mengineyo ambayo yana uhusiano na utafiti huu, tafadhali wasiliana na: Mwenyekiti, Tume ya Utafiti wa Magonjwa ya binadamu (**NIMR), S.L.P. 9653 Dar es Salaam, Simu+25522 2121400.**

Una swali lolote mpaka sasa?

Je, naweza kuanza mahojiano sasa?

AMETOA RIDHAA (Zungushia jibu sahihi)

NDIO = 1 HAPANA= 2 →→→ FUNGA MAHOJIANO

SAHIHI YA MHOJIWA_____TAREHE_____

ALAMA YA DOLE GUMBA _____ TAREHE_____

Annex 5: Final tools (English and Swahili versions)

Table 1-4: Tool 1: School identification and summary form

S/N	SCHOOL NAME	SMNS SCHOOL ID	HEAD TEACHER MOBILE PHONE NO	NUMBER OF PUPILS			NUMBER OF PUPILS TESTED FOR MALARIA		NUMBER OF PUPILS WHO TESTED POSITIVE FOR		NUMBER OF PUPILS TESTED FOR HAEMOGLOBIN CONCENTRATION		NUMBER OF PUPILS WITH HB LEVEL <8G/DL		NAME OF A NEARBY HEALTH FACILITY	DISTANCE (KM) AND TIME (MIN) FROM THE SCHOOL TO THE HEALTH FACILITY	GPS
				FEMALE	MALE	TOTAL	F	M	F	M	F	M	F	M			
1																	
2																	
3																	
4																	

Identifier of reporting officer: _____ Date: _____ (Automatically captured)

Table 1-5: Tool 1: Fomu ya utambulisho wa shule na muhtasari wa vipimo

NA	SCHOOL NAME	SMNS SCHOOL ID	NAMBARI YA SIMU YA MWALIMU MKUU (MOBILE)	IDADI YA WANAFUNZI			IDADI YA WALIOPIMWA MALARIA		IDADI YA WANAFUNZI WALIOKUTWA NA VIMELEA		IDADI YA WALIOPIMWA HB		IDADI YA WALIOKUTWANA HB<8G/DL		JINA LA KITUO CHA KUTOLEA HUDUMA YA AFYA KARIBU	UMBALI (KM) AU MUDA (DK) TOKA SHULE HADI KITUO CHA KUTOLEA	GPS
				KE	ME	JUMLA	KE	ME	KE	ME	KE	ME	KE	ME			
1																	
2																	
3																	
4																	

Identifier of reporting officer: _____Date: _____ (Automatically captured)

Table 1-6: Tool 2: Malaria RDT, Hb and DBS collection form

NA	PUPILS' SMNS ID	FULL NAME OF THE PUPIL		HB LEVEL (G/DL)	MALARIA TEST				
			SEX OF PUPIL		CONTROL	PAN	*PF*	INTERPRETATION (POS; NEG)	REMARKS (E.G. INVALID, REPEATED TEST)
1									
2									
3									
4									

Table 1-7: Tool 3: PUPIL QUESTIONAIRE

Interview Start Time |__|__|__|__| 24-hour format	
Pupil's details	
Name of the pupil _____ **Pupils' SMNS ID (e.g. 001, 002):** _____	**Class |_____|**
Date of Birth: |_____|_____|_____| (**DD/MM/YR)** **Sex of the pupil** 1. M 2. F **(Circle the appropriate response)**	**Body Temperature (˚C)** |_____|_____|:|_____|
Section A: Household details	
A1. How many people usually live in your household? ***(including yourself)*** [___ [___] **(If more than 10, enter "10")**	
A2. How many people slept in your household last night? ***(including yourself)*** [___ [___] **(If more than 10, enter "10")**	
Section B: Knowledge and methods to prevent malaria	
B1. Malaria disease is transmitted by _____. 1. Mosquito 2. Others mention……...	
B2. Are you aware of methods used to prevent malaria **1.** Yes **2**. No (If no**, go to question B3)**	
B2.1. If yes, mention methods that are used to prevent malaria **(*circle the correct answer[s]*)** 1. Mosquito nets 2. Indoor residual spray (IRS) 3. Topical mosquito repellent 4. Spatial mosquito repellent 5. Mosquito spray 6. Destruction of mosquito breeding sites 7. Others (specify) 8. I don't remember/I have forgotten	
B3. Have you ever seen or heard any message about different methods that can be used to prevent malaria? **1**. Yes **2**. No B3.1 If yes, where did you learn about this? (***circle the correct answer[s]***) 1. Television 2. Radio 3. Billboards 4. Newspapers 5. Posters and leaflets 6. School/books/teacher 7. Others (specify)……. 8. I don't remember/I have forgotten	
B4. Do you have a mosquito net at home? 1. Yes 2. No [If no**, go to question B9**]	

B4.1. If yes, how many mosquito nets do you have? |_____|

B5. Do you usually sleep under a mosquito net? **1**. Yes; **2**. No

[If yes**, go to question B7**]

B6. If no, why don't you sleep under a mosquito net?

1. There are not enough
2. There are no mosquitos
3. Makes me feel hot
4. I don't like to
5. Any other reason (specify)……

B7. Did you sleep under a mosquito net last night? **1**. Yes; **2**. No

[If no**, go to question B9**]

B8. How many of you slept under one mosquito net?

[If more than 4 enter **"4"** [_ _]

B9. Have you ever received a mosquito net here at school? 1.Yes 2.No

Section C: School Absenteeism and Fever

C1. In the past two weeks, have you missed going to school?

1.Yes 2..No

[If no**, go to question C3**]

C2. Why did you miss school?

1. I had a fever
2. Other sickness/illness
3. Other reasons (specify)……

[If the response is not 1 **go to D1**]

C3. In the past two weeks, have you experienced a fever or raised body temperature?

1.Yes 2. No

[If no**, go to question D1**]

C4. Did you get treatment? **1**. Yes **2.** No

[If no**, go to question D1**]

C5. Where did you get the treatment?

1. Health centre/hospital/dispensary/ [If the response is not 1, **go to D1**]
2. Pharmacy
3. Traditional healer/herbalist
4. Other reasons (specify)……

Section D: Knowledge on Malaria treatment

D1. Have you ever seen or heard any announcement emphasizing a malaria test before drug use? (e.g. "Not every fever is malaria.")

1. Yes 2. No [If no**, go to question D3**]

D2. If the response is yes, where did you see or hear it? (circle the correct answer)

1. Television
2. Radio
3. Billboards
4. Newspapers
5. Posters and leaflets
6. School/books/teacher
7. Health workers

8. Others, specify…….

9. I don't remember

D3. Have you ever seen or heard any announcement on malaria treatment? [If no**, go to question D5]**

1. Yes
2. No

D4. If the response is yes, where did you see or hear it? (circle the correct answer)

1. Television
2. Radio
3. Billboards
4. Newspapers
5. Posters and leaflets
6. Health workers
7. School/books/teacher
8. Others (specify…)…….
9. I don't remember

D5. What is the recommended drug for malaria treatment? (circle the correct answer)

1. Artemether-lumefantrine (ALu)
2. Artesunate injection
3. Others (specify)……
4. I don't know

Section E: Health Status – This Section Should Be Filled In by the Lab Technician and/or Drug Dispenser

E1. Malaria results **1**. Positive **2**. Negative [_____]

E2. If malaria positive, have they been given any medication?

1. Yes **2**. No If no, give reasons_____

E3. Haemoglobin (Hb) Concentration/ levels (g/dl) _____

Signature of the interviewer …… End of interview |__|__|__|__|(AM/PM)

Section F: Assessment of Different Food Groups Intake in the Past One Week

Q1. Over the **past week**, how often did you eat **dark green leafy vegetables**? Includes fresh and cooked vegetables, eaten separately or as part of a composite dish.	
Example of foods in this groups: spinach, amaranth, sweet potato leaves, cassava leaves, pumpkin leaves, cowpeas, turnips and mustard greens	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q2. Over the **past week**, how often did you eat **cruciferous vegetables**? Includes fresh and cooked vegetables, eaten separately or as part of a composite dish.	
Examples of foods in this group: cabbage (white or red), broccoli, Brussels sprouts and cauliflower	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q3. Over the **past week**, how often did you eat **dark orange vegetables and fruits**? Includes fresh, frozen, canned or thermally processed fruits and vegetables, eaten separately or as part of a composite dish. Include only whole fruit, not juices.	
Examples of foods in this group: carrot, pumpkin, sweet potato, mango, papaya, apricot and beetroot	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q4. Over the **past week**, how often did you eat **other vegetables**? Includes fresh and cooked vegetables, eaten separately or as part of a composite dish.	
Examples of foods in this group: eggplant or African eggplant, tomato, paprika/pepper (sweet or hot), okra, cucumber, onion and zucchini	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q5. Over the **past week**, how often did you eat **citrus fruits?** Includes fresh and cooked fruits, eaten separately or as part of a composite dish. Include only whole fruit, not juices.	
Examples of foods in this group: orange, lemon, grapefruit, tangerine, lime and grapefruit	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q6. Q6. Over the **past week**, how often did you eat **other fruits**? Includes fresh, frozen or canned fruits. Includes only whole fruit, not juices.	
Examples of foods in this group: avocado, pineapple, guava, tamarind, baobab and berries	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q7. Over the **past week**, how often did you eat **legumes?**	
Examples of foods in this group: beans (e.g. kidney beans, soybeans, black beans, yellow beans), peas (e.g. green peas, cowpeas, pigeon peas, but excludes peanuts), lentils (e.g. red lentil, brown lentil and yellow lentil)	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q8. Over the **past week**, how often did you eat **nuts and seeds?**	
Examples of foods in this group: nuts (e.g. peanut, Bambara nut, groundnut, walnut, cashew and almond), seeds (e.g. pumpkin and sesame), nut or seed butter (e.g. tahini and peanut butter)	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week

Q9. Over the **past week**, how often did you eat **poultry?** Excludes luncheon meats, hot dogs, organ meat, chicken nuggets, and pâté.	
Examples of foods in this group: chicken, turkey, duck and pigeon	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q10. Over the **past week**, how often did you eat **fish?** Includes any fish, including fresh, cooked, baked, fried, canned or smoked. Excludes shellfish.	
Examples of foods in this group: oily fish (e.g. Nile perch, trout, sardine, tuna etc.) and whitefish (e.g. tilapia)	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q11. Over the **past week**, how often did you eat **whole grains?** Includes cereals, porridges, pastas, breads and baked goods containing at least 50% whole grain.	
Examples of foods in this group: unrefined corn (e.g. on the cob, whole grains, whole grain corn flour bread or "Dona" ugali and porridge), millett (e.g. porridge and cereals), other whole grains (e.g. brown rice and unrefined sorghum ugali "mtama")	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q12. Over the **past week**, how often did you use **liquid oils?** Excludes semisolid oils (e.g. palm and coconut oil)	
Examples of foods in this group: sunflower, corn, canola (rapeseed), soybean, sesame and cottonseed	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q13. Over the **past week**, how often did you eat **white roots and tubers?**	
Examples of foods in this group: cassava, plantain, banana, yams, potato (e.g. Irish, white, yellow and sweet potato) and other roots and white tubers	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q14. Over the **past week**, how often did you eat **red meat?** Includes muscle and organ meat as a main dish or as a part of a composite dish.	
Examples of foods in this group: beef, veal, lamb, goat, pork and wild meat	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q15. Over the **past week**, how often did you eat **processed meats?**	
Examples of foods in this group: sausage, salami, ham, bacon, cured meat and frankfurter	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q16. Over the **past week**, how often did you eat **refined grains and baked products?**	
Examples of foods in this group: Ugali from refined maize floor, cassava, sorghum and others, white rice, "vitumbua", refined pasta (e.g. chapati, white bread, dognut, pie, pasta and baked goods)	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q17. Over the **past week**, how often did you drink **sugar-sweetened beverages?** Excludes coffee or tea, milk or cereal-based sugary drinks, home-made juices and diet drinks with artificial sugar.	

Examples of foods in this group: sodas/soft drinks (e.g. Coca-Cola, Pepsi, Fanta, Sprite and local varieties [excludes diet sodas]), energy drinks (e.g. Red Bull and sport drinks with added sugar [excludes sugar-free drinks]), commercial fruit juices and fruit drinks with added sugar	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q18. Over the **past week**, how often did you eat **fried foods away from home?**	
Examples of foods in this group: local street foods (e.g. fried cassava, sweet potato, meat, fish and veggies), international varieties (e.g. hamburger, French fries, chicken nuggets and cracklings)	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q19. Over the **past week**, how often did you eat sweets and ice cream?	
Examples of foods in this group: candy (e.g. hard, soft and gummy [excludes sugar free], chocolate bar, chocolate cake, cookie, sugar cane ice cream and cake with cream	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q20. Over the past week how often did you eat milk or its products?	
Examples of foods in this group: real milk, yoghurt, cheese ghee, butter, etc.	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week
Q.21. Over the **past week,** how often did you eat eggs?	
Examples of foods in this group: hen, duck, goose and other bird eggs	□ Less than 1 time per week □ 1 time per week □ 2–4 times per week □ 4–5 times per week □ 6 times or more per week

Table 1-8: Tool 5: School Nutrition and Health Environment

Section A. Please answer the following:

	YES	NO
a. There are many shops, markets or other places to buy things within easy walking distance of the school.	☐	☐
b. There is a large selection of fresh fruits and vegetables available in shops and stores in this neighbourhood.	☐	☐
c. There are many food restaurants or vendors that sell high fat, high sugar, low-quality foods in this neighbourhood.	☐	☐

Section B. School health, physical activity and nutrition environment observation

6. Which of the following describes the condition of the school/buildings/surrounding area?

	Yes	No
a. Running water and drinking taps for pupils	☐	☐
b. Availability of safe and clean water		
c. Playgrounds/tracks and fields	☐	☐
d. Enough toilets for pupils	☐	☐
e. Handwashing stations	☐	☐
f. Food store	☐	☐
g. Dining space/canteen	☐	☐
h. Kitchen	☐	☐
i. School farm/vegetable gardens	☐	☐
j. Pupils' nutrition clubs	☐	☐

Section C: School feeding programme

Does your school provide any food and nutrition service to the pupils?

a) ☐ Yes

b) ☐ No (go to question 12)

7. If yes, what services are offered? Tick where appropriate:

☐ Provision of food

☐ Provision of micronutrient supplements

☐ De-worming tablets

☐ Physical activities

- ☐ Entertainments and other sports
- ☐ Health and nutrition screening
- ☐ Other services (specify)…….

8. Who manages the entire school feeding programme in your school?
   - ☐ School feeding committee
   - ☐ Head teacher
   - ☐ Head teacher and health (food) teacher
   - ☐ Others (specify)
9. Where does the school get food supplies for the school feeding programme? (Choose all that apply)
   - ☐ Market
   - ☐ School farm/vegetable garden
   - ☐ Parents contribution
   - ☐ Other sources (specify)……
10. What types of food are served at school? mention……
11. Which classes benefit from the school feeding programme?
    - ☐ All classes
    - ☐ Pupils with special needs
    - ☐ Some classes (mentioned)…….
12. In your opinion what are the challenges/limitation affecting the implementation of the school feeding programme? (Tick all appropriate answers)
    - ☐ Lack of infrastructure
    - ☐ Lack of human resources
    - ☐ High cost of implementation
    - ☐ Poor community engagement
    - ☐ Inadequate support from the government/private
    - ☐ Lack of clear policy and guidelines
    - ☐ Lack of awareness among stakeholders
    - ☐ Inadequate sensitization of stakeholders
    - ☐ I do not know
    - ☐ No challenges/limitation
    - ☐ Others (mention)…….

13. Are there formal or informal vendors at or adjacent to the school? If so, please indicate the items that are sold by these vendors?

a) Yes

b) No

If yes, please tick the items below that are sold by these vendors.

	Yes	No
Sweets snacks (sweet biscuits, candy bars, chocolate)	☐	☐
Baked foods (bread, scones and cashew nuts)	☐	☐
Carbonated drinks containing added sugar (soda)	☐	☐
Vegetables (green and root vegetables)	☐	☐
Fruit juices containing added sugar	☐	☐
Flavoured milk with added sugar	☐	☐
Milk, cultured milk and yogurt		
Cooked meals (starch/protein, e.g. rice/ugali)	☐	☐
Water	☐	☐
Fried foods (buns, chipsi, rice, chapati, samosas, potato and cassava crisps)	☐	☐
Savoury snacks (crisps, salted nuts, popcorns)		☐
Meat skewers and sausages	☐	☐
Fruits, including local/traditional fruits	☐	☐
Ice cream/ice lollies	☐	☐
Others: _____	☐	☐

Table 1-9: Tool 6: Provision of Anti-Malaria Medicines Register

S/N	PUPILS' SMNS ID	FULL NAME OF THE PUPIL	SEX OF PUPIL	WEIGHT	NUMBER OF ALU TABLETS GIVEN TO THE PUPIL	REMARKS
1						
2						
3						
4						

Table 1-10: Tool 7: Malaria RDT Quality Assurance Form

NO.	CONCORDANT	DISCORDANT	BLOOD SPLATTER	RED COLOURATION ON THE READING WINDOW	CORRECTLY LABELLED	RESULTS WRITTEN ON THE DEVICE	REMARKS

Table 1-11: Tool 8: Concordance check form

NO.	ABSOLUTE FREQUENCY OF			REMARKS
	RECHECKED MRDTS	CONCORDANCE	DIS-CONCORDANCE	

Annex 6: Handover form (Fomu ya makabidhiano)

JAMHURI YA MUUNGANO YA TANZANIA

WIZARA YA AFYA

MPANGO WA TAIFA WA KUDHIBITI MALARIA (NMCP)

MAKABIDHIANO YA REGISTER YA VIPIMO VYA MALARIA NA FOMU YA UTAMBULISHO WA SHULE KATIKA NGAZI YA HALMASHAURI/MKOA

Mratibu wa Malaria Halmashauri ya Jiji/Mji/Wilaya/Manispaa…….. nimekabidhi fomu ya utambulisho wa shule na register ya vipimo vya malaria yenye jumla ya watoto …….. kutoka shule ya/za (andika school IDs na onesha idadi katika mabano kwa kila shule) ……. kwa mratibu wa malaria mkoa/msimamizi wa utafiti kutoka wizara ya afya. Ikiwa idadi ya shule /wanafunzi ni pungufu toa sababu hapa……...

Jina la Mratibu Halmashauri ……**Sahihi** …… **Tarehe** ……...

Jina la Mratibu Mkoa ……**Sahihi** …… **Tarehe** ……...

Annex 7: Investigation team

Table 1-12: Investigation team

NAME OF THE INVESTIGATORS	ROLE
Frank Chacky	Principal Investigator
Ally Mohamed	Co-instigator
Samweli Lazaro	Co-instigator
Pendael Machafuko	Co-instigator
Witness Mchwampaka	Co-instigator
Susan Rumisha	Co-instigator
Prosper Chaki	Co-instigator
Samafilan Ainan	Co-instigator
Grace Moshi	Co-instigator
Saul Epimack	Co-instigator

Table 1-13: Data collection team

DAR ES SALAAM	MWANZA	SIMIYU
National Supervisor Grace Moshi Sebastian Njau-Ilala Josephine Kitundu - kinondoni Shufaa Uvilla- Temeke Nuru Pangani- Ubungo **Regional Supervisors** Ford Chisogela Constatine Mzava **Council Team** Ally Adinani Omary Bachi Clemence Shayo Abdallah Said Hemed Lucy Stanley Shirima James Edward Msami Gloriana Msengi Martha J. Kussaga Rosemary J. Mmasa Julius Fupi Florence N. Kalasira Paulina D. Millinga Ester Kazungu Rehema Peter Scanderia Mamboya Eniharda Sanyika Rashid Hamadi Veronica Msungu	**National Supervisor** Lilian Lyatura **Regional Supervisors** Saula Beichumila Juma Shigella **Council Team** Evaristus J Mganga Sundi Elias Kabuli Antony Alberto Dobeye Joyce Kawite Kasimbazi Dismas Simon Dotto Amos Steven Samwel Omahe Abdulrahman MGONJA Redempta Kibiti Martine Machela Daniel Chacha Kahabi Magesa Zera Nchimbi Salma Masokola Lucia Samike Maryna George Deogratias Hangi Rahel Membo Eliakimu Malima Nelly Gama Pilli Malimi Felister Budotela Emmy Chibona Raymond 0nyona Victor Ngalaba Mussa Pangije Magdalena Bryceson Celestine Maningina	**National Supervisor** Angela H Maguhwa **Regional Supervisors** James J. Mvanga Charles Mahonga **Council Team** Ridhwan Hussein Jonas Chambila Andrew Silas Jackson Mtenga Muyabhi Mugeta Mariam Thomas Petro P. Simon Juliana Limbu Rukia Shaban Musa D. Amos Mihayo Magele Maua Joseph Deodatus Limpunga Jeff P. Manyala Menacy R. Kikungwe Juliana F. Mwakatenya Hennerico B. Kasongo Charles Mabula Muyabhi Mugeta Peter simon Menacy R Kikungwe Juliana Mwakatenya Masoud Mikidad Paschal Jilala

DAR ES SALAAM	MWANZA	SIMIYU
	Frank Bikaniko Bertha Donald Yusuph Mkama Edina Kakuru	

KAGERA	KILIMANJARO	KATAVI
National Supervisor Joseph Iekule **Regional Supervisors** Julian Mugengi Mbakileki Audax **Council Team** Maximillian Mulasan Idd Mrisho Luhaga Issa Noel Simon Deodart Ngaiza Devitha Mutesigwa Hawa Tulla Matiko Senke Boniphace Kayegeji Lilian Katundu Derick Rwiza Aisha Murshid Nkwimba Limbe Victor Buchwende Prosper Jumbe Jeronimo Bahati Pontian Katabarwa Redempter Selestine Salvatory Ignas Mzamiru Juma Goreth Zilyahuramu Deonarda Damian George Christian Adolf Fulgence Elnestus Lukumba Amina Nobeye Andrew Felician Philbert Kashaija Madina Kibiriti Eliana Yoweri Norbert Nicholaus Mugisha Rubagola	**National Supervisor** Joyce Lyimo **Regional Supervisors** Rachel Mkandya Jonas Mcharo **Council Team** Yusuf M. Kileo Alberta Makule Joyce Shirima Sophia Kombe HappnessNdanshau EmaculataMgaza Catherine Mdetele Livingstone Puma Shadrack S. Mziray LoshoNkya Conjeta A. Kessy Matha Lameki Anusiata Mgimba James Munisi Ismail Shayo Rozalia M mbaga Beata A. Kimaryo Eva L. Kweka Mathiasi Luzabiko Victor Siriwa Andrew F. Sangalala Johnson Kiravu Beatrice Mtui Catheline Laswai Peleus Richard Salome A. Kissimb Magdalena Masawe Filbert Primus	**National Supervisor** Bwire Willson **Regional Supervisors** Ramadhani Karume Jeniva Evarist **Council Team** Noah Pius Venance Tesha Zera Masoud Best Jeremiah Arnold Fungo Faith Palali Lucas January Victor Lutajumurwa Kelvin G. Ngotho Peter Said Nyamafu Alex Kanzin Joseph Kisese Mahamoud Muharami Amour Mbowela Maimuna Hitami Christopher Pondamali Ntambi Miokoba Shufaa Mnyika Pauline Mpangamila Oliver Joseph

MBEYA	IRINGA	MOROGORO
National Supervisors Pendael Mchafuko **Regional Supervisors** Violeth Paul Mashaka Juma **Council Team** Aman Hassan Joel Mlowe	**National Supervisor** Neema P. Nkini **Regional Supervisors** Rashid Nguruka Julius Kahengu **Council Team** Pius Myonga Kokubelwa Samlelwa Anjelo Mbugi	**National Supervisors** Sia A. Mboya **Regional Supervisors** Wahida Mtiro Judith Mutan **Council Team** Evance Mlaponi Nicholous Mkenda James Kingu

Elinollara Sulley Arestides Mjwahuzi Happy Yobu Neema Msambazi Emmanuel Dalika Godfrey Lelo Rehema hiluka Konzeta Ngachenga Desderia Mbena Isaka Kyando Kulwa Kihinga Laurian Patrick Jovin Rwegasira Fredrick Malunde Esther Ngani Sophia Mwasomola Rebecca Heperwa Darius Limandola Yonah Msyani Karim Pongo Shukran Gaya Mary Chambo Allan Alphonce Monica Panjala Frank Lazaro Jeremiah Makoye	Kilugala Matutu Ikeko A, Singo Reginald Lukas Nuru Mwangosi Onesmo Mgaya Nickson M. Mbungu Ephron Msuva Eustack N Gutambi Jamse Mfuse Furaha Kasomo Eileen Matalu Annamary Ndingonje Moses Mtono Amantha Haule Paul C. Daffa Joseph Safari	Salma Abdallah Masumbuko Chaula Witness Nsellu Felix mloka Meleji L Mollel Discipulus Domino Sangusangu Mwalimu Geofrey Dastan Liwemba John Lusinde Magnus Mlaponi Said Ibrahim Omary kombo Severa Mroso Simplicia Mjokonde Bahati Mbogo Vinius Samwel Rose Awetty Festo Luambano Martine Busangawa Felister Ngaga Limbu Paul Fransisca Horota Abel a. Sanga Emiliana kishinda Frank Njau Lupogo Lupogo Nicolous Ntabaye Mariam Manyori Yovitha Baragamba Eugenia Mbena John Boaz Kitua Kulwa Bunyogwa Paulo Maliki Marupu	G
TABORA	**ARUSHA**	**RUKWA**
National Supervisor Ester C. Kawishe **Regional Supervisors** Nassoro I. Kaponta Bonaventura D. Makingi **Council Team** Hassan Kapamba Juma A. Juma Elisha E. Maige Daniel Sizya Vicent M. Cosel John Romanus Nyeho Ndoya Mbogo Mohamedd Maalim John Ernest Lilian Ndyamkama Robert Kamoga Devotha Mselle Felix Mangara Andulile Francis Winfrida John	**National Supervisor** Joyce A. Assey **Regional Supervisors** Exavery B. Toke Warda Kaita **Council Team** Amani G. Mmanyi Emmanuel Muna Bety Mngombelo Baraka Maira Aziza Said Rose Mtweve Denikyada Munuo Ismail Mohamed Izack Massawe Yona Senzota Esther C. Charles Samson Sagday Grace Shadrack Felix Kilave	**National Supervisor** Julieth Silao **Regional Supervisors** Ally M. Rubeba Marykiada Mwanji **Council Team** Deus Msafiri Shabani Athumani Evelyine Ngoli Nandy Jilala Hamza Kikoba Tito Luhazi Edwin Noah Andrew Ezra Aloyce Alex Mwanisawa Domicia

Masalu B. Washima Zuhura M. Mosha Wenceslaus A. Msita Anizia M. Msiita Feliciana F. Muyaga Flavian Mark Ashiri Shea Abdulkarimu Rajabu Veronica E. Mbele John Abel Nombo Evelina Pastory Maria Fungo Bernard Masanja Fransisco kibiki Jessey Joram Sanula Ngamba Hami Omary Ezrom Kasunzu	Mary Koillah Emmanuel Shayo Didas M. Misana Mwajei Ngonai Batuli H. Kisaya Praygod Kitiri Erasto Kyando Joseph Kikoti Pamela Materu Magdalena M. Sulle Prosper Corner Kija N. Sija Somoe Ponera Faustin S. Mbeyu Zakia Malomba Aziza. Sigera Happines M Ndashau Emaculata Mgaza	
SINGIDA	**LINDI**	**MANYARA**
National Supervisor Nancy Ngalisoni **Regional Supervisors** Habibu Said Mwinory Sekunda Kimaro **Council Team** Musa D. Mpimbili Paul Julius Temba Senzota Ng'wandu C. Msanga Jonalfred Kyense Monica P. Said Martha M. Kinyau Agnes B. Peter Philip Kitundu Prisca Msenga Mafanikio C. Mamba Sarah N. Mkumbo Selina L. Magesa Albert V. Clement	**National Supervisor** Josephine Isaac **Regional Supervisors** Alex Khamis Julius Mwansimba **Council Team** Dominick Kitego Mfaume Hemed Borgia A. Mangaya Beatrice A. Shayo Sophia R. Chinjala Bosco Chilongola Lucy S. Mahua Lawama S. Mtonya Magreth Chinguile Joseph B. Labisai Shaibu H. Ulochi Rehema S. Mkalola Peter Auma Kawaida Lijei Peter Shija Suleiman Juma Shaban Mwijae Asha S. Mbwana Daudi Lugisa Joyce Amuli Yohana Felix Millanzi Bertina Namkoko Kadri A. Juguju Faraja Hassani	**National Supervisor** Egria Dastan Mallongo **Regional Supervisors** Evance Dabrick Simkoko Bobert Makala **Council Team** Ayoub G. Semdumbe Mary A. Ombay Faustin Mbeyu Zakia Malomba Kija N. Sija Somoe Ponera Juma S. Mkesso Charles M. Msengi Archimedes Mpemba Juliana P. Mtey Asteria S. Mwacha Epimark A. Manyanda Zakaria Nyinyimbe Samson R Sagday Kija Nyankari Sija Fidesta S Uberath Loema B. Awtu Kelvin Shukia
SONGWE	**KIGOMA**	**NJOMBE**
National Supervisor Agnes Abel Mpinga **Regional Supervisors** Agnes Njalika	**National Supervisor** Wiggins Aron **Regional Supervisors** Godfrey Smart	**National Supervisor** Fidelis Mgohamwende **Regional Supervisors** Valeliana Jacob Makasi

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GEITA	**Shinyanga**	**MTWARA**
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Salum mgude Simon Juma	Nestory Kishoa	Angela hyera Edward Makunja Kazibure Juma Rehema Mpokwa Festo Ulanga Samson Msomi Wilson Kisengule Anna Shekaoneka Elizabeth Ulanga Mathew Maluchila Phillip Laizer Evans Millanzi Mektidis Nanguka Joshua Mwakajinga
PWANI	**MARA**	**DODOMA**
National Supervisor Grace Mosi **Regional Supervisors** Mhando Muya Denia Kapinga **Council Team** Othman Masanga Nasour Ibrahim Nasour Hadija Suleima Omar Asifiwe Kibanda Neema Rweimamu Seif Mng'ombe Twinomukama Phidelis Halima Shomari Amos John Silivia Mwingila Mariana Beno Nicolous Sillanda Mudathil Khamis Kalamu Isabela Kipesile Gasper Mzeru Hija Maruga Shadhir Yusuph George Kakandilo Rehema Mbunda	**National Supervisor** Justine Omolo **Regional Supervisors** Damian G. Maswola Zephania Nzungu **Council Team** Nicholaus B. Nnsiko Maria Inviolata Subira Susan A Sangoro James N. Allan Abdallah Mohamed Njate Amos Manya Octavian M Bisare Antony Lucas Nyakiboya Jafari Hamisi Majengo Shukran N. Hezron Bernad Y. Mkande Florence F Njiku Samwel P. Maiga Pauline C Mathias Marina Ngairo Taabu M. Lazaro Colitilida M. Kapeche Damian G Malolo Tabitha Mugini Hellen Bunini Albinius Kilina John Makebu	**National Supervisor** Neema P. Nkini **Regional Supervisors** Paul Julius Mageni Jane W. Kiango **Council Team** Athumani H. Benta Melkizedeck F. Kongola Flora John Mkanza Renatus Kadati Mohamed Mikina Dafrosa Mbuya Helman Alfred Restituta P Gama Mwamini Rajabu Uvilla lazaro kibiriti Kondela Sima Fatma Rashid Donasiana Njuu Rose Nkinda Anotsitse Sanga Vendelino G. Raymond Marcelina A. Themai Gasper Kisenza Robert S. Tesha Frank John Mohamed Msokola Petronila Ulomi Gladness Mfugale Asha Mpendakazi Frank J. Ndunguru Martha Ndigomo Augustine Seganje Yusuph Roya Cassian Lembile Mohamed Msokola Stavelian Mathias Daniel Francis
RUVUMA	**TANGA**	**TANGA**
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Table 1-14: Data management team and report writing team

Supervisor	**Frank Chacky** **Susan Rumisha** **Stanslaus Mafung'a**	**Pendael Machafuko** **Samweli Nhiga** **Felista Mwingira**	**Witness Mchwampaka** **Samafilan Ainan**
Data Entry Clerks and laboratory personnel	Wiggins Aaron Rehema Mlay Adrea J. Macha Angela H. Maguhwa Joyce A. Assey Magreth S. Mauky Josephine Isaac Simon Simumba Sebastian Njau Ramadhani Hemedi	Gregory Mmasi Nasser Milulu Ashraf Rwabigimbo Stanslaus Mafung'a Meshack J. Haule Elvila Mfuse Grace Kiiza Bwire Wilson Brigitha Msoffe Witnes Saitot	Frank Chacky Sarah Rubagumya Fidelis Mgohamwende Michael Clemence Ulimbo Agnes Mpinga Halima Kibarizi Pendael Machafuko Felista Mwingira Witness Mchwampaka Martha Adrian
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Annex 8: Data management report

The National Malaria Control Program (NMCP) held a three-week working session to process, verify and clean the data collected for the School Malaria and Nutrition Survey (SMNS) soon after it was collected. Data entry, sorting, organizing and repacking of Dried Blood Spots (DBS) was conducted at Jakaya Kikwete conventional center in Dodoma for two weeks (24th January -6th – February 2022). Data cleaning and coding was held in Morogoro at Kibo peak palace hotel for one week (7th February – 13th 2022). Participants were of different professional backgrounds; statisticians, information technology (ICTO), laboratory scientists, Medical doctors, researchers and data clerks from various institutions including UDSM, MUHAS, IHI, SUA NIMR and NMCP.

Picture 1: Data sorting and entry processes

Picture 2: DBS sorting and repacking Process

Data Entry Process

A template for data entry in ODK was prepared in a restriction manner to prevent erroneous values and typing errors. Identified data entry clerks were oriented on the template, overview of the survey, nature of the data, data collection tools used, variables collected and code used. Confidentiality of the results was emphasized. Data entry exercise was monitored and guided by data entry supervisors for whole two weeks. Data clerks were given an opportunity to ask questions/concerns for clarifications and emphasize was given to ensure template and questionnaires were understood and clear. Team was advised to conduct regular self-checks for own performance, continuously “save” and ask if something is unclear or any ambiguity experienced.

Table 1-15: Data entry general comments and recommendations

S/N	VARIABLE	CHALLENGE	SOLUTION/WHAT WAS DONE	STATUS
1	Region Name	None	N/A	N/A
2.	Council Name	Some council names were not written at all, and some labelled as using other names eg. Kigoma Ujiji instead of Kigoma MC, Kahama MC instead of Kahama TC	• The council was labelled from sampling database using ward name, school name and ID • Consulting the supervisors of the respective region	Done
3.	Ward	Some of ward names were labelled using names which were not in the sampling database (using common names, misspelling)	• The data were entered based on the School ID and names from sampling database. •	Correction of names to be addressed during data cleaning
4.	School Name	Some of school names were labelled using names which were not in the sampling database (using common names, misspelling)	• The data were entered based on the School ID and names from sampling database	Correction of names to be addressed during data cleaning
5.	School ID	-Exchanging of school ID within the council (e.g. in Kilosa council) -School ID were not written at all	• The data were entered based on the School ID and names from sampling database and comparing information from other tools eg. Tool 3	Pending
6.	Date of testing	Date of testing was not written at all in some schools.	• Date of testing was extracted from pupil's cards	Done
7.	Pupil's ID	Duplicates of pupil's ID, missing of some IDs or pupil's ID not written at all	• Pupil's ID were verified by using pupil's registration cards	Some to be verified during data cleaning
8.	Pupil's Full name	Some pupils' name could not be read properly in Tool 2.	• Verification was done using Tool 3 that was submitted using ODK	Done
9.	Sex of the pupil	Sex column were not filled for some pupils in Tool 2 or incorrectly labelled	• The Not filled option was used.	To be checked during data cleaning
10.	Hb level	Hb level was out of range for few pupils (e.g., 37.7g/dl), labelled LM	• Hb level out of range were not recorded	Pending
11.	Malaria test (results)	• Some pupils had results without tick in control column • Some pupils had no interpretation of malaria test results (Neg, Pos) • Some students had malaria Positive results without tick in control, pan or pf • Inconsistence of results in tool 1 and 2.	• An option of ***no malaria test*** results was used • An option of Not filled was used	Pending
12.	DBS collected	Some schools were not indicated if they collected DBS	An option of Not Filled (NF) was used	Done
13.	Tool 2	Some of councils submitted photocopies instead original copies which made difficult in reading. e.g., TEMEKE	Registration cards was used	Done

1. Data collectors (laboratory technicians) should use the capital letters in filling pupil's information especially in Tool 2
2. Names of councils, wards and schools should match across all tools and sampling data base
3. Data clerk's personnel should be well documenting their file after data entry process in order to minimize the duplicates or missing some of the documents.
4. Data collectors should be close supervised in order to minimize challenges during data management process.
5. Committed individuals should be recruited as Data collectors
6. The SMPS team should find a way of motivating supervisors/teams who demonstrate good performance and take strong measures for those who did not meet the target.

Data cleaning and coding process.

This process involved checking for data completeness, duplication and integrity of data values for tool 1-5. All data cleaning process were done and documented in a well-documented stata do file. Below are the five set of activities done for each dataset.

1. Removal of duplicate records and/irrelevant observations

Primary key field (identifier) for each data collection tool was identified and assessed for duplicate. Most of the duplicate observations were caused by multiple submission or errors in entry of pupil ID or school Ids. School id was a primary key for tool 1 and 5 while a concatenated key (school id and pupil number) was the primary key for tools 2, 3 and 4.

The process of removing duplicates records was as follows; All records entered prior to 16th of September (before the beginning of field work) were removed from the dataset. It was assumed that these records represent pilot/dummy data entered during the training. Further, a set of duplicated record in terms of all variables was also dropped for each form. The remaining duplicated records were resolved by following the algorithm below;

i. For two set of duplicate record,
    a. a record with complete records was retained
    b. if all two records were complete, the one entered first was retained.
ii. For three cases of duplicate records
    a. a record with incomplete information was dropped first
    b. for the remaining pairs, the records entered first with complete dataset was retained.

A concatenated primary key and the date of data collection was used in handling most of the duplicate records. Furthermore, incorrect values were identified and compared to the paper forms or electronic forms submitted in other tools.

2. Fix structural errors

The raw data contain all variables and values in Swahili format. The team had to name all variables following the proper naming format, coding values of variables and assigning values and variable labels in to them in English. Further, new variables were generated from variables containing free text field and assigned codes to them. The naming conversion of variables in tool 1, 2, 3, 4, and 5 was t1, t2, t3, t4, and t5 respectively.

3. Filter unwanted outliers

All numeric variables (Hb level, age, etc) were checked for consistence and outliers. Review of physical forms was done to aid the changes made to the data. Identified outlaying values were validated against the physical file, with the remaining ones coded as missing values.

4. Handle missing data

Tabulation of variable in the dataset was done to identify missing values. Where possible, actual values were entered with the aid of physical files. All true missing values were assigned a missing code.

5.Validate and QA

- Data from all tools were merged for the purpose of triangulation. Variables contained in more than one tool that capture the same information such as sex, HB level, age etc were compared. This help identifying duplicated records or mismatch between tools.

- Below is a summary of key challenges encountered during the process and a remedial action taken to resolve them.

Table 1-16: Challenges encountered and remedies

No.	Description of the challenges	Remedies
1.	**Missing hardcopies of tool 1 forms from three regions;** • **Iringa - only forms from Mufindi DC** • **Lindi - forms from all councils were missing** • **Dar es salaam- Available forms were from Temeke and Kigamboni TC**	– Number of students were compared from tools2 and 3 – Other councils of dare s salaam region used the electronic forms only
2.	Some of school had the different names in various tools. e.g. in tool 1and tool 2	Names of schools and IDs were compared using the sampling frame file and review of the physical forms. Proper Id's were assigned to the dataset
3.	Mismatching of the number of records between the tool sent electronically and hardcopy for the same tool.	The number of records for each tool was explored from different forms and what was reported from the regional field report. The missing records were re- entered into the system
4.	Mismatching of school IDs across tools for the same schools. e.g. tool 1 (hardcopy) and its soft copy.	There was error in the electronic data capture system as some of the school's name were not in the drop-down list hence interview had to select random name to be able to proceed with data entry. Checking of school IDs used across all tools (tool 1, 2, and 3).
5.	Duplication in terms of; a) Pupils IDs with different recorded information. b) Pupils name with misrelated information. c) School names with the same recorded information.	Registration cards were used for verification.
6.	Mismatching of the same pupils' records across tools. Eg tool 3, tool 2 and registration cards	Error in entry of pupil ids. Review of the physical form and making change to the forms
7.	Altitudes and nearest health facility were not recorded in some tools. Eg tool 1.	The team communicated with district malaria focal person to ask the distance to the nearest health facility the schools that were missed
8.	Incorrect recording of pupil from one school to another in the same tool.	Registration cards were used for verification.

9.	Most of school of school names were confused with wards. Eg instead of writing exactly school name then ward was written as a school name	School IDs, wards, and school names were rechecked across various tools for assurance.
10.	Excess number of pupils recorded in some tools in relation to other tools in one school	
11.	The same data with different structure were interred with dissimilar structure across zones.	Each data structure was named differently and then data set and variables were combined.
12.	Altitudes were not recorded in most of schools	Other reference was used to find out the missed altitudes.
13.	Some of schools missed their records from the tool 2.	Missed schools were re-entered in the ODK

Recommendations

- The IT officer tasked to design questionnaires in the system (ODK) should cooperate with statistician in order to ensure uniform structure of the data that will be collected This will help to reduce uneven structure of data across zone which will be good aid in data set merging.
- Issue of toilet should be captured in the next survey for the purpose of Wealth quintile in relation to Malaria and poverty.
- National supervisor to access sever in his/her supervision site. This will help to reduce the duplicated data.

DBS sorting, organizing and repacking

Activities undertaken were;

i. Organizing and packing DBS- filter papers into labelled envelopes per school, district and region.
ii. Arranging DBS Filter papers in serial order of student IDs and pack them in serial order for each school.
iii. Identifying DBS filter paper and sort the positives and negatives samples using mRDT results indicated in Tool 2.
iv. Identifying and documenting all missing DBS Filter papers in each school and district level.
v. Identifying, documenting and reporting all any DBS Filter papers with incorrect label in reference to Tool 2.
vi. Identifying and separating all invalid DBS Filter papers with invalid IDs.
vii. Identifying and separating poor quality DBS filter papers which cannot be used in laboratory analysis.

1. Working TOR

i. Quality of filter paper used
ii. Correctness of labelling
   - Correct ID
   - dates
   - time
   - pupils' initials
iii. Packaging
iv. Quality of the Dried blood spot
   -adequate size

-quality of blood spot (dryness, mold formations etc.)

v. Organization of DBS
   - Missing samples
   - Discordant samples from tool 2
   - Duplicates

2. Results

The DBS team worked on DBS Filter papers from 26 regions of Tanzania mainland. A total of 63,982 samples were sorted, arranged and repacked in serial order. Only 1/26 region was incomplete due to missing samples in two schools of Ilala district in Dar es salaam (See table below).

Table 1-17: DBS collected per region

No.	Region	Schools	Total DBS	status
1	Arusha	32	3,033	DONE
2	Mtwara	22	2,244	DONE
3	Katavi	12	1,207	DONE
4	Iringa	16	1,613	DONE
5	Tabora	32	3,237	DONE
6	Njombe	18	1,728	DONE
7	Ruvuma	24	2,292	DONE
8	Lindi	14	1,433	DONE
9	Mara	28	2,799	DONE
10	Dodoma	31	2,763	DONE
11	Mwanza	37	3,465	DONE
12	Geita	23	2,336	DONE
13	Shinyanga	19	1,874	DONE
14	Morogoro	32	3,229	DONE
15	Tanga	30	2,931	DONE
16	Songwe	14	1,425	DONE
17	Singida	20	1,902	DONE
18	Kigoma	28	2,852	DONE
19	Pwani	20	2,015	DONE
20	Dar es salaam	52	5,007	DONE**
21	kilimanjaro	30	2,952	DONE
22	Simiyu	19	1,930	DONE
23	Rukwa	17	1,413	DONE
24	Mbeya	21	2,108	DONE
25	Kagera	34	3,316	DONE
26	Manyara	29	2,878	DONE
	Total	**654**	**63,982**	

3. Issues observed

Generally, in comparison to the previous SMPS survey of 2019: -

-The quality of DBS in the 2021 survey was fairly better

-The amount of reject DBS was remarkably lower

-Labelling of DBS (time, pupils initials, dates, and school IDS) has improved

General Issues observed

i. **Observation:** The team observed that the samples were not in order, samples from different regions were mixed up in the same boxes.
Implication: This implies that the mix-up of samples from several regions happened at the project headquarters where all the samples were delivered.

Recommendation: The team recommends the programme to have a specific team in place to receive and store the samples in conducive environment before data management is done.

Solution: All samples were sorted by region re-packed and labelled in different boxes.

Observation: The DBS samples were made from different types of materials other than those provided by the project.

Table 1-18: Samples rejected

No.	School id	region	district	No. of samples rejected
	Tb/ura/03	Tabora	Urambo	10/87
	KI/Sam/05	Kilimanjaro	Same	88/120
	MO/MoM/02	Morogoro	Morogoro district	34/72
	DA/ubg/01 DA/ubg/03	Dar es salaam	Ubungo	17/108 94/120
	PW/KiB/01	Pwani	Kibaha	13/96
	KV/MpW/01	Katavi	Mpanda	8/96
	MW/Mis/02	Mwanza	Misungwi	35/120

Implication: The materials provided by the project for making DBS were inadequate in some settings. It also implies that the field team ran out of materials thus opted to use other material including (ordinary papers, hand towel/tissues/ other filter papers to make DBS. Other filter paper types may not preserve the integrity of nucleic materials required and may also not persevere in laboratory analysis such as DNA extraction process.

Recommendation: The Programme management should ensure adequate materials are procured and disseminated timely, to maintain the quality of the samples.

The QA team in each region should maintain constant communication with the field teams to ensure shortage of materials is solved timely to avoid compromising the study.

ii. **Observation: Many IDs on the DBS were written incorrectly** and did not conform to the project/programme generated IDs.

Table 1-19: Incorrect IDs

No.	Incorrect ID	Correct ID	Region	District
1	Sh/KMC/	Sh/KaT/	Shinyanga	Kahama-MC
2	PW/KTC/001	PW/KiT/001	Pwani	Kibaha
3	AIA/Bat/001 CA/Bat/001	Used pupil initials in place of region	Manyara	Babati
4	KL/MoD/	KI/MoD	Kilimanjaro	Moshi-DC
5	MWZ/SeD or MZ/MaG	MW/	Mwanza	Sengerema, Kwimba and Magu

Picture 3: DBS were written incorrectly

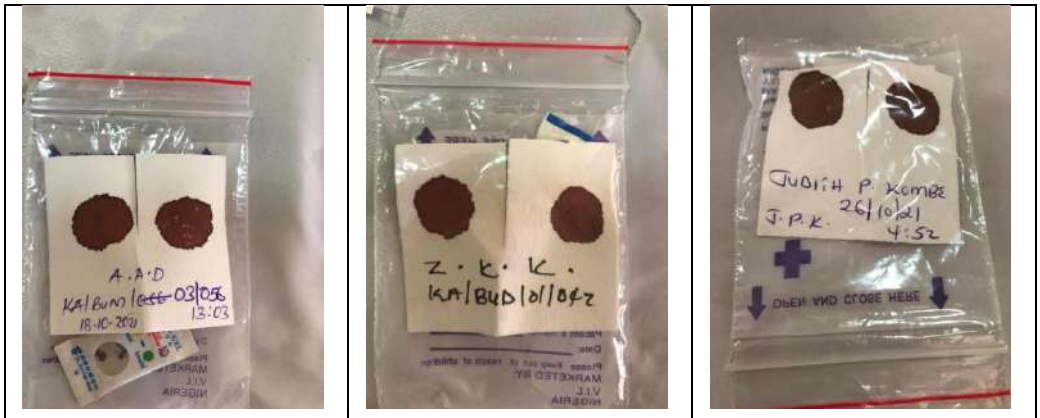
Implication: The field team used the familiar acronyms for regions or district that were not provided by the project. Similarly, the field team used student registration numbers and school identity numbers to generate student IDs, indicating that the importance of using project generated IDs was not stressed and the QA failed identify it as a problem for the whole school.

Recommendations: The project management should continue to stress the use of the project generated IDs during the orientation seminars. In addition, the regional quality assurance team should be strengthened and assure that the IDs used are correct as part of the QA check for each school. These regional QA results should be submitted to the national level database.

The Laboratory technicians should be stressed on the importance of writing correct information on the filter paper to increase readability for use in the preceding lab analyses.

iii. Observation: Some DBS samples were incorrectly labelled

Some IDs used did not match with the IDs in Tool 2. Similarly, some schools swapped IDs and or sample sizes from those provided by the project.



No school number	No time and date	No ID number

Picture 4: Incorrectly labelled DBS samples

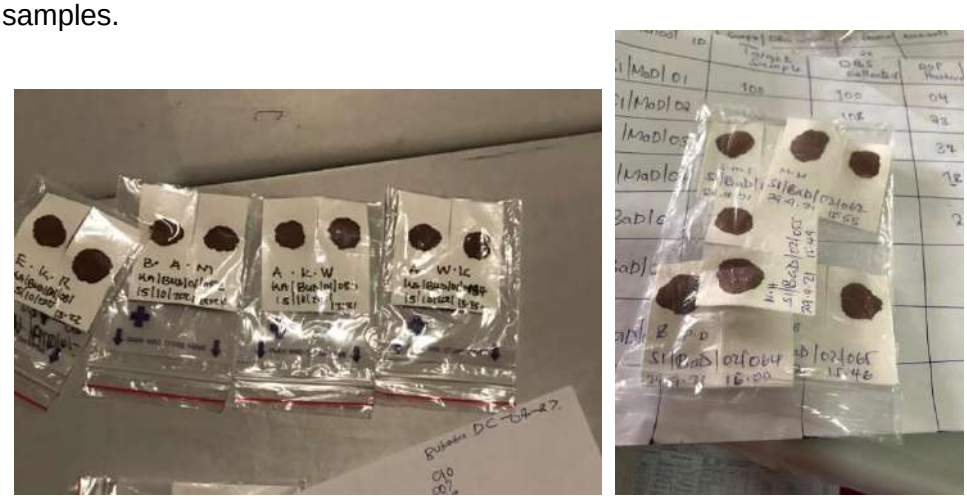
Implication: The field team did not realize the importance of using project IDs and failed to provide information to the project in case of swapping of school IDs or sample sizes.

Recommendation: The project team should stress on the importance of using the project IDs and QA should be done regularly during the field surveys to ensure correct IDs are used and that the DBS labelling matches the Tool 2 IDs.

Solution:

All samples were relabelled to include the missing school ids. However, time and date were not confirmed hence left unlabelled.

V. Observation: Some DBS samples were packed without desiccants or drying agents and this might allow fungal growth and in turn, compromise the quality of DBS samples.



Picture 5: Samples were packed without desiccants

Implication: Most samples from Kagera- Bukoba district council, Simiyu were not packed with desiccant(s). This indicates that, poor communication between the field team, RMFP, national supervisor in lack of reporting the lack of such important materials. In addition, the field team was not aware that the same desiccants could be obtained from the mRDTs packages.

Recommendation: The QA team should be strengthened and all issues observed during the field surveys should be reported at national level for immediate action.

Solution: all samples were placed in separate plastic bags with desiccants.

VI. Observation: Poor quality of DBS samples

Some DBS were either decayed of had irregular shapes including bool sputters, some had blood on only one side of the filter paper and other were not made from a free-falling blood drop unto filter paper.

		
Irregular shaped	*Mold*	*Poor quality*

Irregular shape

Blood splutter

Poor quality

Blood splutter

Blood on one side of FP

Picture 6: *Examples of Poor-quality DBS samples*

Implication: Although all the samples were packed with drying agent the decayed ones were most probably due to being stored in plastic zip lock bags before they were completely dry. This further entails that the work of placing DBS filter papers in bags was done by not only the laboratory Technicians but also by other members of the team who could not identify a completely dry sample from a wet sample. Furthermore, it might be that some samples were collected late in the evening and hence needed longer time to air dry in comparison to those samples collected relatively at morning or noon hours, thus the team did not wait for them to dry completely. Similarly, it shows a weakness in the training of the laboratory technicians prior to embarking in the field work.

Recommendation: We advise that surveys should be done early enough (during the start of school hours) to have enough time to bleed and air-dry samples before they pack and leave the school premises. Also, the packing of DBS like any other laboratory related activity should be done by technicians at all circumstances to reduce errors.

The training of the field team (lab technicians) should be improved and RLTs follow up in the field should be mandatory.

VII. Observation: Some DBS samples were made of inadequate volume of blood resulting into micro blood spots.

Picture 7: Samples that had inadequate amount of blood.

NB: blood should cover at least a circle of 2.5 cm in diameter.

Implication: DBS were made of inadequate amount of blood which may compromise the analysis of the samples.

Recommendation: QA process should be strengthening, RLT training to be improved and if possible, all technicians should be trained centrally.

VIII. Observation: Poor DBS samples packaging.

Some DBS were packed together in the same bag. i.e. multiple samples came into contact with each other. Other were not packed in separate plastic bags e.g., (Mwanza)

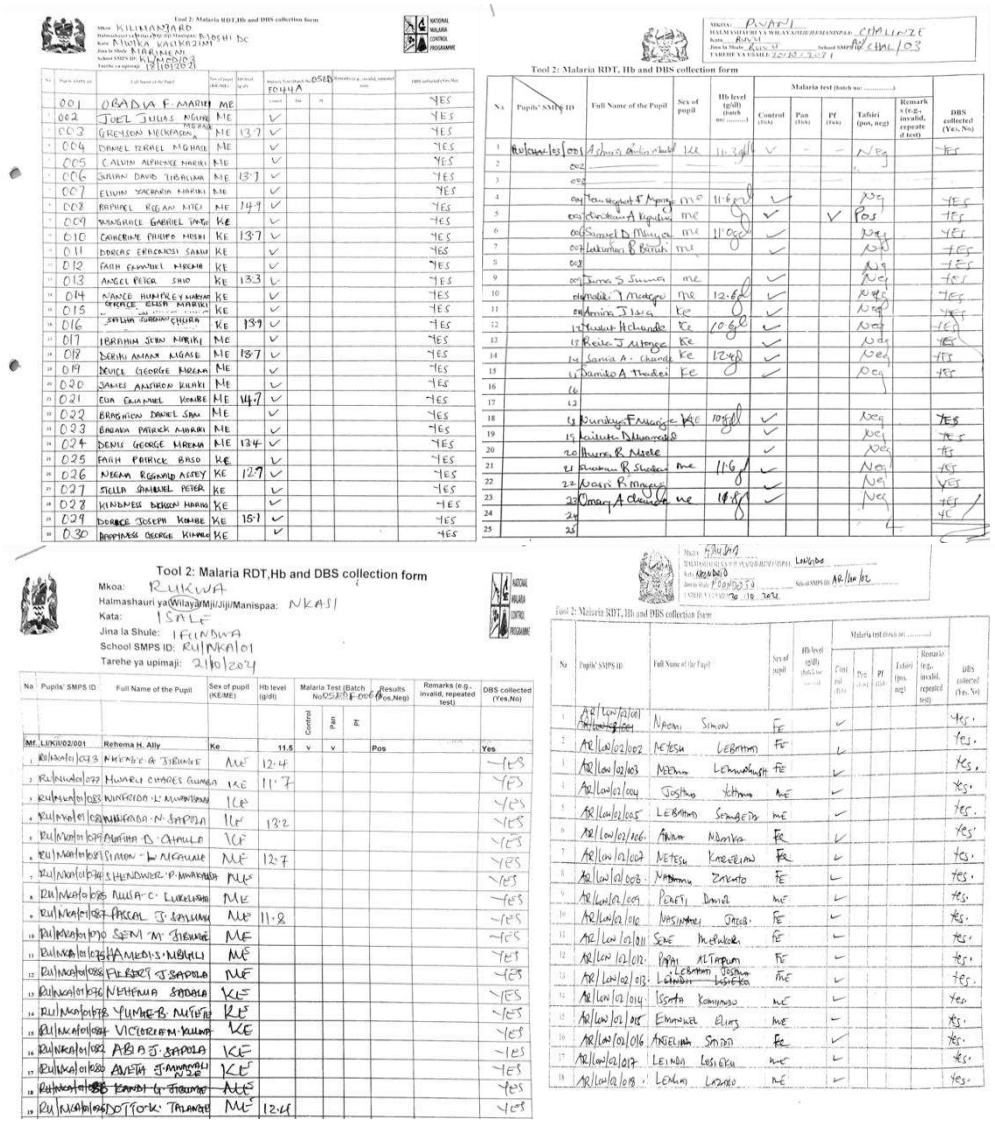
Pictures 8: Poor DBS samples packaging

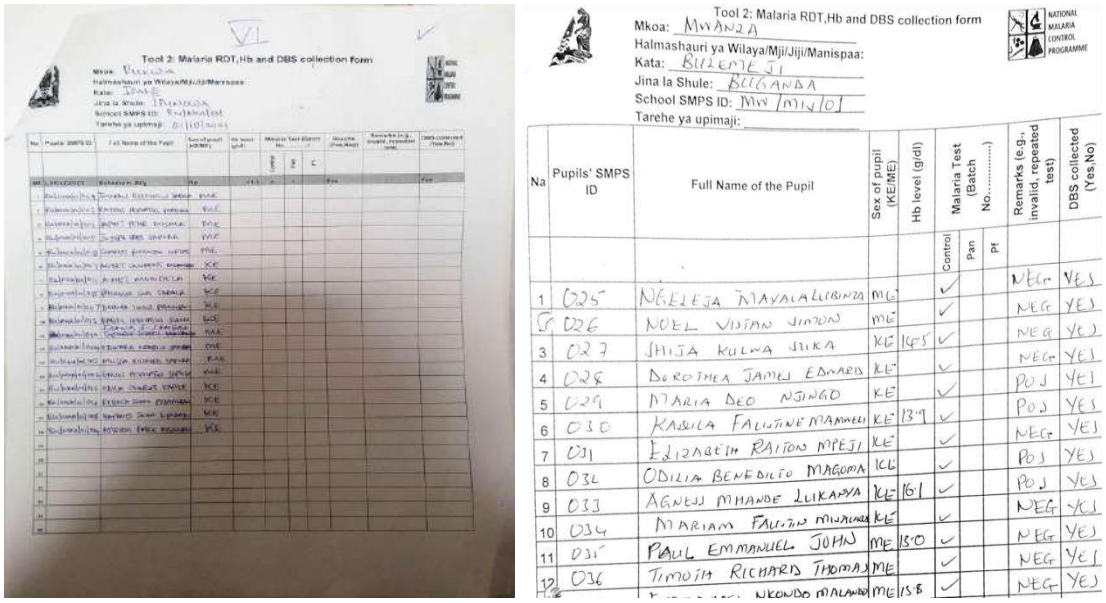
Implication: Either, the laboratory technicians did not get any /adequate training from their respective RLTs. OR the work (mostly packing was done by other non- lab technicians without knowledge of the basic principles of handling blood samples to avoid cross contamination of the samples.

Recommendation: The District Lab Technicians (DLTs) should receive the same training as the RLTs from the national level to reduce incompetence and discrepancies caused by trickle-down of information.

IX. Observation: Issues with tool 2

- Discordance between the number of DBS samples and number/names of pupils in Tool 2.
- Poorly filled tool 2
- RDT results not filled
- RDT results not interpreted
- Missing names and details of some students
- No indication whether DBS was collected or not





Tool 2: Malaria RDT,Hb and DBS collection form

Mkoa: MWANZA
Halmashauri ya Wilaya/Mji/Jiji/Manispaa:
Kata: BUZURUGI
Jina la Shule: BUGANDA
School SMPS ID: MW/MIN/01
Tarehe ya upimaji:

Na	Pupils' SMPS ID	Full Name of the Pupil	Sex of pupil (KE/ME)	Hb level (g/dl)	Malaria Test (Batch No.....) Control	Pan	Pf	Remarks (e.g., invalid, repeated test)	DBS collected (Yes,No)
1	025	NGELEJA MAYALA LUBINZA	ME		✓			NEG	YES
2	026	NOEL VISTAN JIMON	ME		✓			NEG	YES
3	027	SHIJA KULWA JIKA	KE	16.5	✓			NEG	YES
4	028	DOROTHEA JAMES EDWARD	KE		✓			POS	YES
5	029	MARIA DEO NJINGO	KE		✓			POS	YES
6	030	KABULA FAUSTINE MAMMELI	KE	13.9	✓			NEG	YES
7	031	ELIZABETH RAITON MPEJI	KE		✓			POS	YES
8	032	ODILIA BENEDICTO MAGOMA	KE	16.6	✓			POS	YES
9	033	AGNESS MHANDE LUKANYA	KE	16.1	✓			NEG	YES
10	034	MARIAM FAUSTINE MHAGAMA	KE		✓			NEG	YES
11	035	PAUL EMMANUEL JOHN	ME	13.0	✓			NEG	YES
12	036	TIMOTH RICHARD THOMAS	ME		✓			NEG	YES
		NKONDO MALAMBO	ME	13.8	✓			NEG	YES

Picture 9: Examples of poorly filled TOOL 2

X. Other issues included:

- A substantial number of missing DBS samples and duplicated IDs.
- Discordance between the expected number of students to be sampled and the actual number of pupils sampled on the day of survey.
- Some schools under sampled (samples fewer pupils than required e.g. Arusha MC
- Some schools swapped school ID number and other schools use one ID for two schools e.g., Kilimanjaro.

General Recommendations

i. The programme/project should stress the use and adherence to the SMPS Standard Operating Procedure (SOP)/Protocol for DBS activities during the survey. The SOP addresses all issues related to procurement of adequate and recommendable materials for DBS –FP preparation, handling and storage.
ii. The QA team should be strengthened and include checking for not only mRDT quality but also the quality of DBS –FPs and the use of correct SMPS IDs. In addition, the QA information should be synced in the national database for immediate mitigation of any pressing issues discovered during the QA process.
iii. The programme should design a mechanism of commitment for all trained laboratory technicians to take part, in person in the survey. The Programme PI(s)/ National supervisors should be given mandate to request for all RLT/DLTs who were trained by the programme to take part in person during the survey. Personal replacement/assignment or swapping of trained staff with untrained staff should be highly discouraged to avoid inconsistencies caused by people who go to the field without being trained. Also, all laboratory technicians should be centrally trained to avoid discrepancies arising due to trainer of trainee (ToT) process.

4. Precautions prior analysis

i. Due to the issues observed during the DBS sample management, the following precaution should be taken prior lab analysis: -
ii. Since more than one type of filter paper was used in making DBS, the method of DNA extraction chosen should be able to accommodate both types of filter papers. Attention should be given to other samples whose DBS seem to be made out of ordinary paper.
iii. Due to small amount of blood on some DBS the following lab analysis should be prioritized in order of importance so that all the important analyses should be done using the limited DNA obtained from the inadequate DBS.
iv. Due to human error, some IDs are either duplicated, missing, skipped or unlabelled.

Annex 9: Data rights, availability, ownership and access

The Ministry of Health through the National Malaria Control Programme (NMCP) recognises the importance of data sharing to maximise the value of the SMNS and other research in addressing public health problems, knowledge advancement and education. This annex provides guidance and procedures that shall be followed to access and use data generated from the Tanzania SMNS that promote fairness and integrity of research conduct, providing a safeguard on the rights of the data generators.

The information provided here is applicable to the SMNS core research team of the Ministry of Health at the NMCP, the Nutrition section and other partners. The partners include the National Institute for Medical Research (NIMR), Ifakara Health Institute (IHI), Tanzania Food and Nutrition Centre (TFNC), the University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), Muhimbili University of Health and Allied Health Sciences (MUHAS) and President's Office – Regional Administrative and Local Government (PO-RALG).

Data rights, availability and ownership

All rights over the documents, notes, paper, records and other publications of any nature in any materials produced under the provisions or in execution of the SMNS are protected by the copyright laws of the United Republic of Tanzania and shall be vested by the Ministry of Health through the NMCP.

The Ministry of Health through the NMCP is the primary owner of SMNS data and is accountable for ensuring data storage, security and safety. Paper-based data are stored in limited access and locked cupboards, whereas are dried blood spots (DBSs) stored at room temperature within NMCP offices.

The data collected by this survey are broadly classified as socio-demographic, clinical, molecular (to be generated from DBS), Global Positioning System (GPS) locations, nutrition and other metadata. Different molecular techniques (Deoxyribonucleic acid (DNA) extraction, polymerase chain reaction [PCR], restriction fragment length polymorphism [RFLP] and gene sequencing) will be used to generate data, including but not limited to, *Plasmodium* parasite species, parasite diversity, targeted amplicon sequencing, sickle cell status, G6PD deficiency status, and *pfhrp2* and *pfhrp3* gene deletion. Additionally, serological and biochemical tests can be done to determine different parasite features and micronutrient deficiencies, particularly anaemia (and its aetiology), iodine and vitamin A deficiency.

Electronic data have been uploaded to the Composite Malaria Database of the NMCP, which has a restricted access and a strong password. The Ministry, through the NMCP, has a mandate to share data generated via the SMNS. The NMCP will provide raw data to the SMNS core research team of the Ministry of Health at the NMCP, Nutrition section, NIMR, IHI, TFNC, UDSM, SUA, MUHAS PO-RALG. These research partners shall be eligible to apply for data access, as explained in the "data access and sharing" section, after the main report is disseminated to the public. Likewise, partners will be required to ensure that they produce progress reports 6 months after the data granted. The research partners will be required to acknowledge and share the publication with Ministry through the NMCP.

Data storage and security

Data in electronic, paper and biological (i.e. DBS) forms are kept confidentially, respecting the privacy of the research subjects and in compliance with ethical clearance requirements. NMCP is responsible for ensuring storage and security of the data through responsible, authorised custodians. Further, there shall be a limited access to the soft copy data, which is protected by a strong password.

Data access and sharing

Access requestions and provision of raw data shall follow the procedures detailed below.

- Access to research findings

The Ministry of Health through the NMCP, in collaboration with partner institutions, have the mandate of disseminating SMNS findings through various media channels, including but not limited to stakeholders' dissemination meetings, the main SMNS report, publication of policy briefs, local and international meetings/conferences, ministry of Health, institutional and organizations websites and scholarly publications in open-access journals. Any third-party use of already published material should refer to the original publication by citing a valid source.

- Sharing research data and samples

Data and biological samples (e.g. DBS or DNA samples) obtained in the course of the research can be provided to other interested partners under the negotiated terms of a written material transfer agreement provided by the National Health Research Ethics Review Committee (NatHREC) of NIMR through the NMCP with coordination of the SMNS principle investigator. No data containing variables that allow identification of the study subjects will be shared to any requesting entity.

- Governance of data sharing procedures

The data requestor shall:

a. Apply to the Ministry of Health through the NMCP.
b. Include relevant details in their application, which shall include a concept note outlining the intended purpose for the requested research data, the title of the study and the description of the data requested.
c. Provide a description indicating the novel output from the requested data or the added value that it will provide to address health issues and carrier development.
d. Adhere to all terms of the data sharing agreements. Failure to use granted data as specified in the concept note within the specified period shall mean a loss of the right to continue using the data.
e. Communicate in a timely manner to the Ministry of Health through the NMCP about any alterations on use of the granted data from that specified in the concept note and within a specified period. Failure to do so shall mean loss of the right to continue using the data.

The Ministry of Health, through the NMCP, shall:

a. Verify that the requested data is ready for sharing, subject to the specified exclusivity period of six months after the general report is published.

b. Verify if there is any similar data request granted to another requestor.

c. In collaboration with the principal investigator of the study, assess the partner's application to ensure it meets the minimum criteria for a data sharing request and, in case the application is considered unsatisfactory, request a revision of the application or submission of substantive additional information.

d. The principle investigator, in collaboration with other investigating team of the SMNS study (as indicated in **Annex 7**) shall be involved in the review of the application and decision.

e. Respond to the partner requesting data upon receiving the principal investigator's recommendations regarding approval or rejection of the data sharing request.

f. Compile and share with its partners annual reports of the requests for data sharing. The report should indicate the number (%) of formal requests that were received, the number (%) of accepted requests, the number (%) of accepted requests that were formally referred to the partner for revision or substantive additional information and the number (%) that were declined.

g. Provide reasons for refusing to offer access to data when such as decision is made.

The principal investigator, in consultation with the core SMNS team, shall:

a. Respond in a timely manner to the notification regarding the data sharing application.

b. Provide to the Ministry of Health, through the NMCP, a brief outline of the risks related to the sensitivity of the requested data and any anticipated conflict of interest that may arise.

c. Avail the requested data with appropriate standards to the applicant with notification to the Ministry of Health through the NMCP.

d. Provide to the Ministry of Health, through the NMCP, a statement with justification regarding objections to sharing the data (if deemed so). In the absence of this statement, it will be considered that the principal investigator has no objections to sharing their data.