ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE

SCHOOL OF PUBLIC HEALTH

Relationship between malaria and malnutrition among under-five children in Adami Tulu district, south-central Ethiopia: a case- control study

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Acknowledgements

I would like to acknowledge Addis Ababa University, College of Health Science, School of Public Health for providing me this opportunity to assess the relationship between malaria and malnutrition in under-five children.

My special thanks go to my advisor, Dr. Wakgari Deressa, for his unlimited support, advice, careful guidance and critical reviews for which I will always be very grateful.

I would like to appreciate and express my gratitude for the Norwegian Research Council for funding this MPH thesis work through MalTrial project.

I also thank Professor Bernt Lindtjørn, Ato Seifu Hagos, Dr. Alamayehu Worku, Ato Shimelash Bitew and Dr. Naod Firdu for their valuable comments.

I am very grateful for Adami Tulu health Bureau administration, heads of health centers, data collectors and study participants.

I am very grateful to my family for being there to encourage and support me during the period of study.

Above all, I am always grateful to the most gracious and most merciful, Allah.

List of Abbreviations

AAU	Addis Ababa University
Ab	Antibody
DDT	Dichloro Diphenyl Trichloroethane
EDHS	Ethiopia Demographic and Health Survey
EPI	Expanded Program of Immunization
IG	Immunoglobulin
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
HAZ	Height for Age Z score
HC	Health Center
LLINs	Long lasting Insecticide-treated Nets
MIS	Malaria Indicator Survey
MUAC	Mid-Upper Arm Circumference
OR	Odds Ratio
P I	Principal Investigator
RDT	Rapid Diagnostic Test
SD	Standard Deviation
WAZ	Weight for Age Z score
WHO	World Health Organization
WHZ	Weight for Height Z score

Table of contents

List of Tables

List of Figures

Abstract

Background

Malaria and malnutrition are the major causes of morbidity and mortality in under-five children in developing countries including Ethiopia. Malnutrition is an underplaying cause in about half of all deaths occurring among children in developing countries. However, the relationship between malnutrition and malaria is still controversial. This relationship has not been well documented in Ethiopia.

Objective: The aim of this study was to assess whether malnutrition is associated with malaria among under-five children in Adami Tulu district, South-central Ethiopia.

Methods A case-control study was conducted in Adami Tulu District, south-central Ethiopia. Cases were all under-five children diagnosed with confirmed malaria, in selected health facilities, during the data collection period. Controls were apparently healthy under-five children recruited from the community where cases reside. Mothers/caretakers of under-five children were interviewed using pre-tested structured questionnaire prepared for this purpose. Nutritional status of children was assessed by anthropometric method and analyzed using WHO Anthro. Data were entered using EPi Info version 3.5.4 and exported to SPSS version 21 for cleaning and analysis. Bivariate and multivariate analysis methods were used.

Results: Four hundred twenty eight under-five children comprising of 107 cases and 321 controls were included in this study. The mean age was 28 (SD±14) months for cases and 33 (SD±16) months for controls. Prevalence of stunting was 50.5% in cases and 45.2% in controls. Prevalence of underweight was 24.3 % in cases and 18% in controls. Prevalence of wasting was 17.8 % in cases and 9.3% in controls. Severe wasting (adjusted OR=2.951, 95% CI: 1.145, 7.605), mid-upper arm circumference between -2 and -3 SD (adjusted OR =3.019, 95% CI: 1.457, 6.253) and caretakers who had no education (adjusted OR=2.999, 95% CI: 1.266, 7.102) were independently associated with malarial attack in under-five children.

Conclusion: Those under-five children, who were severely wasted, had MUAC between -2 and -3 SD and with uneducated caretakers had higher odds of malarial attack. Therefore, Malaria control programmes should consider integrating nutritional interventions.

1. Introduction

Malaria is one of the oldest diseases that has been documented since the 6th century BC in which the Greeks had known the relation of fever to wetland. After the recognition of mosquito"s role in the transmission of malaria, different intervention strategies have been undertaken to interrupt further transmission. Reduction in human-mosquito contact using bed nets has been among such tools. In spite of its long history and efforts to reduce malaria, malaria remains a major cause of morbidity, anemia and mortality worldwide (1).

Malaria is a protozoan caused, blood feeding genus of plasmodium, transmitted to humans by the bite of infected female mosquitoes of Anopheline species. It is caused by five species of parasites of the genus *Plasmodium* that affect humans (*P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi*). Among them, *P. falciparum* is the most prevalent and deadly form *of Plasmodium* species (2).

Malnutrition is a widely used term to refer to suboptimal nutritional health (1). In this paper, malnutrition generally refers to under-nutrition (poor growth) rather than over-nutrition even though the term can be used for both. Although there are different methods of nutritional assessment, anthropometric methods have several advantages: less expensive, simple, safe and non invasive. Anthropometric methods refer to measurements of physical dimensions and gross composition of the body which varies with age and degree of nutrition (3). Weight, height and Mid Upper Arm Circumference (MUAC) are the most commonly used measurements in children (1). Individual measures such as weight and height are uninformative on their own. However, when combined with age or with each other and compared to reference values, they create meaningful indices that describe the nutritional status of individuals and population (3).

Stunting or low height-for-age represents long-term (chronic) problem whereas the term wasting or low weight-for-height represents a recent (acute) problem that has led to significant weight loss. Low MUAC has been used as a proxy for wasting. On the other hand, underweight or low

weight-for-age can reflect an acute and/or a chronic problem of nutrition. Since weight-for-age is influenced by both weight and height its interpretation is complex (3).

People living in malaria endemic areas generally live under conditions leading to malnutrition. In addition, children and pregnant women are segments of the population that are most affected by both malaria and malnutrition (1)

2. Statement of problem and rationale

Malaria and malnutrition are the major cause of morbidity and mortality in under-five children. The two major health problems are concentrated mainly in the sub Saharan African countries including Ethiopia. According to the 2012 world malaria report an estimated 3.3 billion people were at risk of malaria worldwide, in which the sub-Saharan Africa takes the highest risk of acquiring malaria. Approximately, 80% of cases and 90% of deaths are estimated to occur in the World Health Organization (WHO) African Region, with under-five children and pregnant women most severely affected (2).

About three-fourth of Ethiopia,s landmass is either malaria-endemic or potentially at malaria rim. Altitude and rainfall are the most important factors determining malaria distribution. In 2009/2010, malaria was the leading cause of outpatient visits and health facility admissions, accounting for 14% of outpatient visits and 9% of admissions (4). According to the 2011 Malaria Indicator Survey, Malaria parasite prevalence in malaria endemic areas was 1.3% by microscopy blood-slide examination for all ages, with 1% of these being *Plasmodium falciparum* and 0.3% being *P. vivax*. However, 60% of slide-positive cases in Oromia were due to *P. vivax* (5).

On the other hand, about one-third of under-five children estimated to be underweight or stunted in developing countries. Sub-Saharan Africa estimated to have 26% prevalence of child malnutrition (6). Based on the Ethiopia Demographic and Health Survey (EDHS) 2011, 44% of children under the age of five years are stunted, 29% underweight and 10 % are wasted (7).

Malnutrition and infection are not only the most important cause of morbidity and mortality in under-five children but also have synergistic relationship. Malnutrition can make a person more vulnerable to infection, and infection also contributes to malnutrition, which causes a vicious cycle (8).

A variety of intervention strategies have been used to combat malaria, including insecticide treated bed net, chemoprophylaxis and prompt and appropriate case management (2). There is no single strategy or solution to fight malaria until recent times; instead, a comprehensive approach is required. Therefore, identifying further predisposing conditions for malaria like malnutrition

broadens the already available intervention strategies to combat the deadly malaria. However, the relationship between malnutrition and malaria continues to be controversial. In fact, there is little evidence on the association between malaria and malnutrition in Ethiopia. This study was aimed at generating evidence on how malnutrition is associated with malaria.

3. Literature review

3.1. Malnutrition and Child Health

The reduction of infant and young child malnutrition is vital in the achievement of the Millennium Development Goals (MDGs) particularly MDG-1 (Eradication of extreme poverty and hunger) and MDG-4 (Child survival). Malnutrition is an underlying cause of over 55% of child deaths that occurred in developing countries (6) . Infectious diseases including Pneumonia, diarrhea, malaria, measles, AIDS and neonatal conditions are responsible for more than two-third of under-five mortality in developing countries and majority of these children were undernourished (9).

Malnutrition and infection interrelate synergistically one worsening the other (10). Malnutrition decrease resistance to infection mainly by suppression of immunity which has been termed as nutritionally acquired immunodeficiency syndrome (11). Malnutrition affects all categories of immunity: humeral (Ab formation) immunity, cell mediated immunity and innate immunity (10).

According to Unicef-WHO-World bank joint child malnutrition estimate, globally malnutrition is widely distributed and affects a large portion of under-five children. For instance, in 2011, 165 million (26%) were stunted, 101 million (16%) were underweight, 52 million (8%) were wasted. Comparatively the prevalence of malnutrition showed a decreasing trend from 1990 to 2011; since the burden has been huge still millions of children remained at risk of death. This burden is mainly accounted by Africa and Asia (12). Ethiopia is among the SSA countries with very high prevalence of malnutrition in under-five children. Thus, 44% of children under the age of five years were stunted, 29% underweight and 10 % were wasted according to the recent national survey(7).

To overcome this problem, Ethiopia has developed national nutrition strategy in 2008 with emphasis to four components. Those are : promotion of Essential Nutrition Actions (improving the nutritional status of women and under-five children), Child growth monitoring and promotion, strengthening nutrition in emergencies, and strengthening food security activities among others (13).

3.2. Malaria in Ethiopia

Fever among under-five children, particularly in malaria endemic areas indicates malarial infection. In Ethiopia the overall fever prevalence among under-five children decreased from 24.0% in 2007 to 19.7% in 2011. In Oromia the prevalence was 15.4% in 2011 (5). A study done in Adami Tulu district in Ethiopia revealed that 21% of children had experienced fever in the last 2 weeks before the survey (14).In this study, Household ownership of a mosquito net and prior spraying of the house were associated with lower risk of febrile illnesses. In addition, a study done in seasonal malaria transmission in rural Ethiopia (Adami Tulu district) revealed that the prevalence of reported malaria was 14% among people assessed during the last 14 days. Family/self-diagnosis was most common and the main first responses included visiting village-based community health workers (CHWs) (33%), public health facility (23%) and private clinic (17%).Home treatment was the least reported first response (3%) (15). In another study in the same district (Adami Tulu) prevalence of malaria was significantly different among three kebeles depending on the malaria prevention strategy used. The total malaria prevalence was 8.6% in Jela Aluto (Did not receive either LLITNs or DDT), 4.4% in Kamo Garbi (received LLITNs), and 1.3% in Aneno Shisho (received LLITNs and DDT) (16).

In malaria-endemic areas, from those tested microscopically, the prevalence of malaria was 1.3%. Nationally, *P. falciparum* constitutes the larger proportion of cases detected by microscopy (77%) in areas <2,000m. In Oromia, however, *P. vivax* was the main etiologic agent of cases confirmed by microscopy, with 60% of slide-positive cases. RDT results revealed that malaria prevalence is 4.5% in malaria-endemic areas <2,000m. Of the total RDT-positive cases, 1.9% was positive for *P. falciparum* only, 1.4% for *P. falciparum* or mixed and 1.1% for *P. vivax*/*P.malare*/*P.ovale (5).*

According to MIS 2011, in areas <2,000m, 55.2% households surveyed own a mosquito net. Oromia was found to have the lowest net ownership. In areas <2,000m, 38.2%, 26.6% of children Under-five had slept under an LLIN the night preceding the survey nationally and in Oromia respectively. In malaria-endemic areas, 46.6%, 43% of all households evaluated had

been sprayed in the past 12 months preceding the survey nationally and In Oromia respectively (5).

The national five-year strategic plan (2011-2015) of malaria prevention and control in Ethiopia aims: scaling up IRS and LLINs, prompt and effective case management using RDT and microscopic diagnosis with Artemisinin-based combination therapy (ACT). Malaria diagnosis consists of a patient,,s clinical assessment, microscopic examination of blood slides and use of multi-species RDT in accordance with the level of the health facility. Microscopic diagnosis remains the standard of diagnosis in health centers and hospitals of different levels, whereas multi- species RDTs are the main diagnostic tool at the health post level (17).

3.3. Malaria and Stunting

Studies revealed contradictory finding on the association between malaria and Stunting (10, 18, 19). A cohort study done in rural Gambia showed children with baseline stunting were at higher risk of experiencing subsequent malaria attack compared to children who were not stunted. This study revealed no association between other nutritional indicators (wasting and underweight) and malaria (18). Another study on the cohort of children in Uganda also showed that children with stunting had a higher incidence of malaria compared to children without stunting (20). In addition, a cross sectional survey done in Equatorial Guinea found that stunting was positively related with *P. falciparum* infection (21). In this study, not having taken colostrum and someone in the household slept under a bed net were also positively associated with P.falciparum infection. A cross sectional study done in Senegal showed that both the prevalence of anti-malarial immune responders and specific IgG Ab levels were lower in stunted children than in control (22).

In the contrary to these findings, a cohort study done in Papua New Guinean children showed that children with a low HAZ score at baseline experienced fewer clinical episodes of *P.falciparum* malaria during the following year (10). Although wasted children tended to be more Sick with malaria than well-nourished children, this study did not show a significant effect of WHZ score on subsequent malaria morbidity. On the other hand, a community based cross-

sectional study done in South- West Ethiopian children showed no association between malaria and stunting (19).

3.4. Malaria and underweight

Two surveys in northern Ghana showed that underweight was independently associated with fever and clinical malaria, with 67% increased odds of malaria in underweight children (23). In addition a study done in Vanuatu revealed *P*.vivax was positively associated with underweight (24) . Similarly a study done in Gambia revealed mean weight for age was lower for malaria patients compared to controls (25). However many studies showed no association between underweight and malaria (19, 20, 26). A cohort study done in rural Burkina Faso revealed no association between underweight and malaria (26). The study done in Uganda showed no significant difference in the incidence of malaria in underweight children (20). In addition, a study done in south-west Ethiopia revealed no association between malnutrition (underweight, stunting, wasting) and malaria (19).

A randomized control trial in Kenya on the effect of ITN on nutritional status showed significantly higher measures of WAZ and MUAC on ITN groups than controls (27). In addition a similar randomized control trial in Kenya revealed significantly higher measures of WAZ on ITN groups than controls (28).

3.5 Malaria and wasting

A hospital based study in Democratic Republic of Congo revealed malaria incidence was significantly higher in children with MUAC<115mm and with nutritional edema (29). A case control study done in Nigeria revealed positive relationship between severe acute malnutrition and malaria (30). In addition the study done in Vanuatu there was a positive relationship between P.vivax and wasting. a study done in *Papua* New Guinean revealed that humeral responses to specific malarial antigens were lowest in the wasted children (10). A retrospective analysis of routine programmers data on Forty-eight nutritional rehabilitation centers in southern Ethiopia showed among malnourished children with fever (Temperature >37.5°C) 28% were RDT positive for malaria. There was a highly significant linear association between malaria

prevalence and increasing grades of malnutrition (31). In the contrary to these ,a cohort study done in rural preschool children in Senegal Revealed wasted children were at a significantly lower risk of having a malaria attack during the following transmission season (22).

4. Conceptual framework

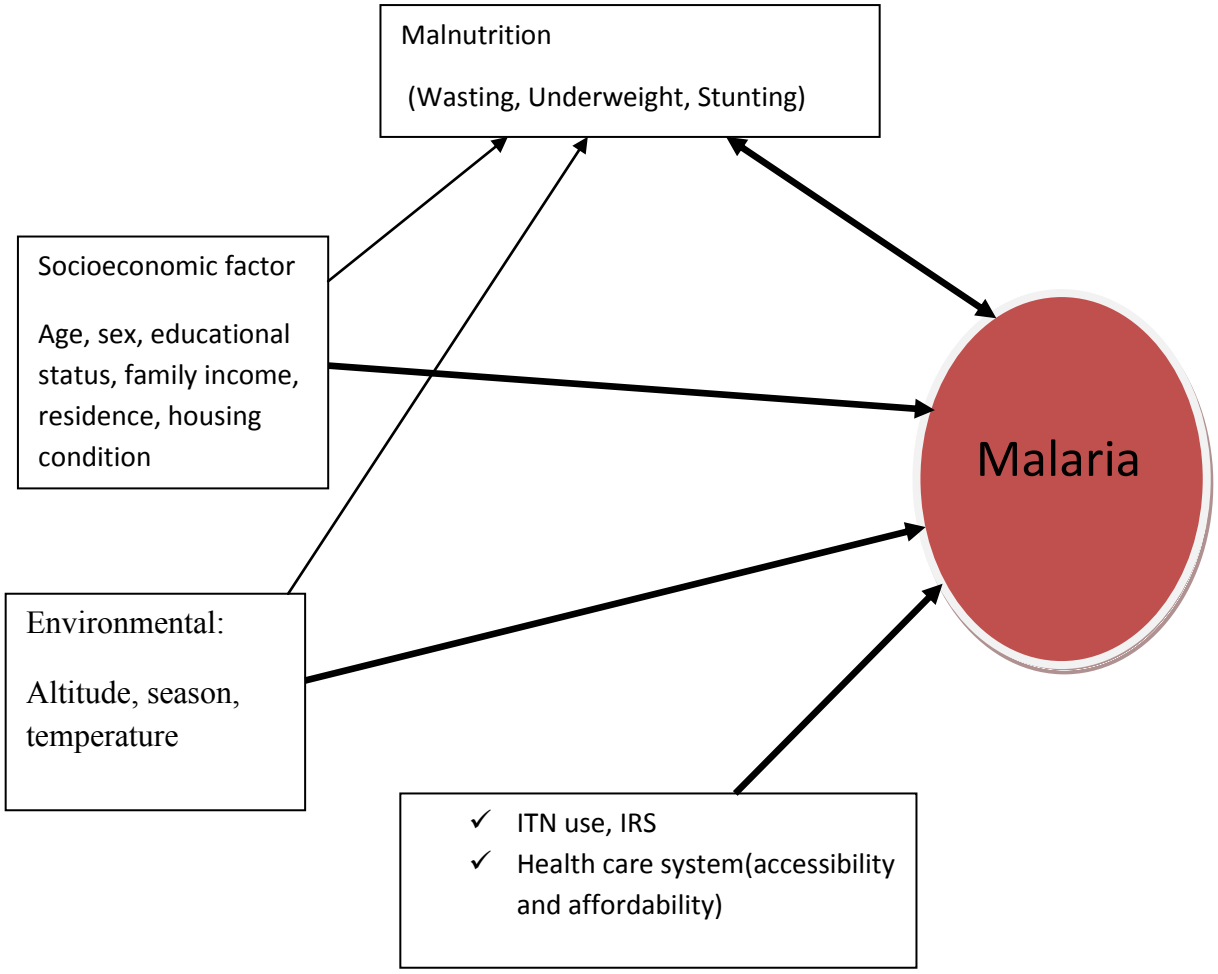

Figure 1 Conceptual Framework for the relationship between malaria and malnutrition

5. Research question

- Is there association between malnutrition and malaria

6. Objectives

- General objective: To assess the association between malnutrition and malaria in under five children

- Specific objectives:
  - To determine the association between malaria and wasting in under five children
  - To determine the association between malaria and stunting in under five children
  - To determine the association between malaria and underweight in under five children

7. Methods and materials

7.1. Study area and population

The study was conducted in Adami Tulu district, which is administratively located in Oromia Regional State. Zeway is the capital of the district which is located at about 160kms south-east of Addis Ababa. The district lies at an altitude between 1,500 and 1,750m above sea level and covers an area of 1,403 km^2. According to the 2007 national census, the population in Adami Tulu was about 150,000 of which 17% were under-five children (32).

Malaria is a major health problem in Adami Tulu District (14). The transmission of malaria in the district is seasonal and major transmission occurs from September to December; following a heavy rainfall. P.falciparum and P.vivax are the most important malaria parasite in the district. Anopheles arabiensis is considered as main vector. In health centers, diagnosis of malaria is made only after confirmed by microscope while RDT is used to diagnose malaria in the health posts (17).

The district has nine health centers, 43 rural health posts. Administratively, the district has 48 kebeles, the lowest administrative unit in Ethiopia. Lake Zeway is used for irrigation and fishing in the district.

7.2 Study design

A case-control study design was employed to assess the relationship between malaria and malnutrition among under-five children, in Adami Tulu District. Cases were recruited from three selected health centers and six health posts in the District. Controls were recruited from the same community where the cases recruited. WHO/EPI sampling technique was used to select controls from the District (33).

7.3 Source population:

The source population was all under-five children in Adami Tulu district

7.4 Study population:

The study population included cases and controls from the selected health facilities and community respectively.

- Inclusion and exclusion criteria
  - ✓ Inclusion criteria
    Age 6-59 month
  - ✓ Exclusion criteria
    Children who were sick due to pneumonia, diarrhea, measles in the last 2 weeks

7.5 Sample size calculation

In this study, confirmed malaria was taken as outcome variable while malnutrition was considered as a major exposure variable. Thus wasting, stunting, and underweight were considered to calculate the sample size. Among them wasting gave the maximum sample size. Sample size was calculated based on double proportion formula for unmatched case control study using Epi-Info Statcalc version 3.5.4. The following assumption was made: 95% confidence interval, 80% power, 10% wasting in controls, OR=2.5, ratio of case to controls 1:3. With these assumptions and adding 5% non-response rate the total sample size became 441 (110 cases and 331).

7.6 Sampling techniques

A total of nine health facilities were purposively selected because of their high malaria patient flow in the district which includes 3 health centers: Bulbula, Zeway and Adami Tulu and 6 health posts: Dodicha, Bochesa, Golba-Aluto, Kurme -bujure, Andola-Chebe, and Urgo-Mecefer. All confirmed malaria cases that were eligible were included, from the selected health facilities, until the required sample size was achieved.

On the other hand, controls were randomly selected from kebeles where cases came from. Sampling of controls was done using similar sampling technique of WHO/EPI cluster sampling method (33). First, a list of kebeles of cases was prepared from the respective selected health facilities. Then, the number of cases from each kebeles was calculated. Those kebeles with more than two cases were considered for control study. A total of eight kebeles fulfilled this requirement. About 90% of the cases were residence of those kebeles. Finally, four kebeles were selected with probability proportional to the number of cases found from the respective kebeles. Randomly selected four kebeles comprised of three rural and an urban kebeles.

The total sample size of controls was allocated for each selected kebeles equally. Then like EPI method (33), a random direction was chosen from the midpoint of each selected kebeles and starting from the first dwelling in each kebeles, interviewers moved from house to house in a predetermined manner stopping at a house where allocated sample size achieved for each specific kebeles. In each household, all eligible apparently healthy under-five children were included and the mother/caretaker was interviewed and anthropometric measurements of under-five children were taken.

The most important reason for selecting controls from the community, rather than the health facility, was due to lack of appropriate control in the health facility. As it is known that most of under-five children visiting health centers/health posts in Ethiopia are due to infectious diseases like pneumonia and diarrhea which are associated with malnutrition which considered as primary exposure variable in this study. Presumably this might conceal or even reverse the association between malaria and malnutrition.

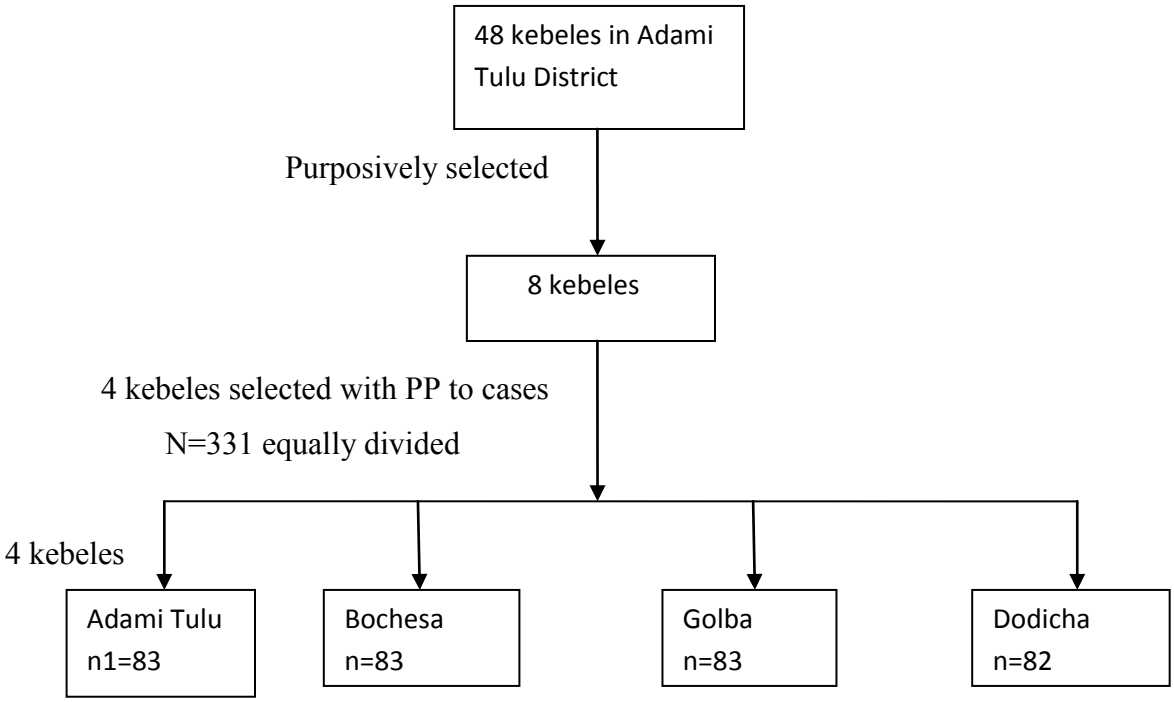

Figure 2: Schematic presentation of control selection, Adami Tulu district, 2014

7.7 Data collection and measurements

Caretakers of children under-five were inter-viewed face to face using pre-tested structured questionnaires in the language of the study area which is afan Oromo. The questionnaire was initially prepared in English and then translated in to afan Oromo and back translated to English by another person. The questionnaire comprised of different parts including socio-demographic characteristics of respondents and children, general knowledge on malaria and nutrition related questions. Most parts of the questionnaires were adopted from EDHS (7) and Malaria indicator survey (5). Some of the questions were from literatures. A total of nine data collectors and one supervisor (health officer‟s and health extension workers) were recruited and trained for two days on the data collection instrument, anthropometric measurement, interview techniques and recruitment of the study subjects.

Weight was measured using digital weighing scale and height/length was measured using length/height board. Height was measured for older children above two years of age, while length of children below two years of age was measured by recumbence scale. Children below two years of old were weighed together with the mother or caregiver. Then the caregiver was weighed alone. Then the difference between the two measurements was recorded as the Child‟s weight. Children aged 2years and above were weighed alone. They were weighed in bare foot and with light clothing. The measurement was rounded to the nearest 0.1kg and 0.1cms, for the weight and height respectively. Weighing scale was calibrated frequently. Mid upper arm circumference was also measured using standard MUAC tape. Local calendar was prepared to improve accuracy in estimating the age of the children.

Digital thermometer was used to measure temperature. Children with suspected malaria in the health centers, blood was taken from finger prick for laboratory confirmation of malaria. For parasite Identification, thick and thin blood smears were prepared for microscopy. Slides were labeled and air dried horizontally in a slide tray. Then, thin films were mixed in methanol immediately after drying and stained with 3% Giemsa for 30 minutes. Finally, blood slides were read and classified qualitatively as negative, *P.falciparum* positive; *P.vivax* positive or mixed infection. In health posts RDT kit was used because microscopes were not available there.

7.8 Data quality assurance

Intensive training was given for all data collectors and supervisors for two days. The training focused on the questionnaire and anthropometric measurements. Data collection instrument was pretested on similar setting but on those who were not participating on the study. Completeness, accuracy and consistency of the collected data were checked during data collection by a supervisor and the principal investigator. Data were coded before data entry. Completeness and consistency of variables were also checked using frequency distributions .The accuracy of weighing scale was checked by placing a weight of 2 kg iron bars on the scale.

Experienced laboratory technicians working at selected health centers prepared blood film for microscopic confirmation of malaria. All the technicians used similar procedures to do the microscopy. Health extension workers working in the selected health post use RDT to confirm malaria.

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7.9 Data processing and analysis

Data was entered using Epi-Info version 3.5.4, then exported in to SPSS version 21 for cleaning and analysis. For the analysis of nutritional indices the data was exported to WHO Anthro software. The nutritional indicators height-for-age (HAZ), weight-for-height (WHZ), and weight-for-age (WAZ) were computed in z-scores of the World Health Organization. Children were classified as stunted, wasted, and under-weight if the HAZ, WHZ, WAZ < -2 standard deviation (SD) respectively. They were categorized as severely stunted, severely wasted or severely underweight if the HAZ, WHZ, WAZ < -3 SD, respectively.

Data was summarized and presented in frequency table, summary statistics. Associations between predictor variables and outcomes of interest were estimated using both bivariate and multivariate logistic regression. Predictor variables with a p-value <0.2 in bivariate analyses was reported and included for multivariate analysis. Final multivariate model was generated using enter method. In the final interpretation of results a P-value <0.05 was considered statistically significant.

7.10 Study variables

- Independent variables:
  - Socio demographic variables like: age, sex, ethnicity, religion, family size, educational status of respondents.
  - knowledge on malaria ,ITN use or IRS etc
  - Primary exposure variables were WHZ, WAZ,HAZ and MUACZ
- Dependent variables
  - Primary outcome variable is malarial attack.

7.11 Operational definition

Case definition: Under-five children with fever or history of fever in the last 48 hours and positive for plasmodium parasite in selected facilities.

Control definition: apparently healthy under-five children and live in the community where cases reside.

Stunting: HAZ< -2 SD, Severe stunting: HAZ< -3 SD

Wasting: WHZ< -2 SD, Sever wasting: WHZ< -3 SD

Under-weight: WAZ< -2 SD, Severe underweight: WAZ< -3 SD

Malnourished: A child with at least one of the three (stunting, wasting or underweight)

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8. Ethical consideration

The proposal was reviewed and approved by the research and ethics committee (REC) of School of Public Health, AAU. The purpose of the investigation was explained to the local authorities and the head of the health centers. Written informed consent was obtained from all mothers/ caretakers who participated in the study after explaining the purpose and objectives of the study. The consent form was in line with the ethical principle of „"autonomy"". Data collection instrument did not include names or any other identifying information about the study participants. Treatment was provided for children with confirmed malaria according to the national guideline in the respective health centers.

9. Results

9.1 Characteristics of caretakers

The background characteristics of caretakers interviewed are shown in Table 1.

Of the total estimated sample size of 441, 428 mothers/caretakers of children were interviewed (making response rate of 97%) of those 107 (25%) were from cases and 321(75%) were from controls.

Most of the caretakers were female in both cases 82 (76.6%) and controls 255 (79.4%). Majority of the caretakers were rural in residence in both cases 82 (76.6%) and controls 247 (77%). By ethnic composition, about 9 in every ten of caretakers were Oromo ethnic group in both cases 98(91.6%) and control 296 (92.2%). By religious affiliation, about two-third of caretakers of cases 71 (66.4%) and 256 (79.8%) of caretakers of control were followers of Islam.

Most of the caretakers of both cases 104 (97.2%) and controls 304 (94.7%) were married. Majority of the caretakers of both cases 70 (65.4%) and 181 (56.4%) controls had no education. 29 (27%) of caretakers of cases and 89 (27.7%) of caretakers of controls reached primary education (grade 1-8). 7.5% of caretakers of cases and 51 (15.9%) of caretakers of controls reached secondary education or beyond. A large proportion of the household in both cases 49 (45.8%) and controls 144 (44.9%) earned average monthly income of less than 500 Ethiopian birr.

Table 1 characteristics of caretakers, Adami Tulu district, 2014

Socio-demographic characteristic		Mothers/caretakers of Cases N (%)	Mothers/caretakers of Controls N (%)
Sex			
	Male	25 (23.4%)	66 (20.6%)
	Female	82 (76.6%)	255 (79.4%)
Age			
	10-19	3 (2.8%)	25 (7.8%)
	20-29	54 (50.5%)	181(56.4%)
	30-39	45 (42.1%)	83 (25.8%)
	≥ 40	5 (4.6%)	32 (10%)
Residence			
	Rural	82 (76.6%)	247 (77%)
	Urban	25 (23.4%)	74 (23%)
Religion			
	Islam	71 (66.4%)	256 (79.8)
	Orthodox	25 (23.4%)	49 (15.3%)
	Protestant	11(10.2%)	16 (4.9%)
Ethnicity			
	Oromo	98 (91.6%)	296 (92.2%)
	Others	9 (8.4%)	25 (7.8%)
Educational status			
	No education	70 (65.4)	181 (56.4%)
	Primary (grade 1-8)	29 (27%)	89 (27.7%)
	≥ Secondary (≥9)	8 (7.5%)	51 (15.9%)
Occupation			
	Housewife	70 (65.4)	193 (60.1%)
	Farmer	27 (25.2%)	96 (29.9%)
	Daily laborer	5 (4.7%)	14 (4.4%)
	Other	5 (4.7%)	18 (5.6%)
Marital status			
	Married	104 (97.2%)	304 (94.7%)
	others	3 (2.8%)	17 (5.3%)
Monthly family income(ETH)			
	<500	44(41.1%)	115 (35.8%)
	500-999	58(54.2%)	158 (49.2%)
	≥1000	5(4.8%)	48 (15%)

9.2 Characteristics of the Under-five children

The background characteristics of the under-five children are shown in Table 2.

From a total 428 under five children included in the study, 70(65.4%) of cases and 179(55.8%) of controls were males. The mean age of children was 28 (SD±14) months for cases and 33 (SD±16) months for controls. The total number of under-five children in the study household was 2 in 54.2% of household of cases and 49.2% of household of controls.15% of the household of controls and 4.8% households of cases had three or more under-five children. The rest had one child.

Table 2 Characteristics of under-five children, Adami Tulu district, 2014

variables		Cases N (%)	Controls N (%)
Sex			
	Male	70 (65.4%)	179 (55.8)
	female	37 (34.6%)	142 (44.2)
Age			
	6-11	15 (14%)	37 (11.5%)
	12-23	28 (26.2%)	65 (20.2%)
	24-35	34 (31.8%)	64 (19.9%)
	36-47	17 (15.9)	66 (20.5%)
	48-59	13 (12%)	89 se(27.7%)
Total no of under-five in a household			
	1	44 (41%)	115 (36%)
	2	58 (54.2%)	158 (49%)
	≥3	5 (4.8%)	48 (15%)

9.3 General malaria knowledge

General knowledge about malaria and its prevention

Almost all of the caretakers of cases 105 (98%) and controls 318 (99%) reported malaria as a major concern of their community. Most of the caretakers of cases 91 (85%) and almost all of caretakers of controls 311 (97%) reported malaria in under-five children is a serious problem. Almost all of the caretakers of both cases 104 (98%) and controls 318 (99%) reported that malaria is both preventable and treatable. 100 (93%) of the caretakers of cases and 280 (87%) of the caretakers of controls reported that sleeping under ITN every night prevents malaria. 100 (93.5%) of caretakers of cases and 306 (95%) reported that DDT spraying protects from malaria.

Knowledge about symptoms of malaria

Caretaker‟s knowledge on symptoms of malaria is shown in Table 3.

Almost all of the caretakers of cases 105 (98.1%) and most of the caretakers of controls 281 (88%) reported fever as a symptom of malaria. Most of the caretakers of both cases 95 (88.8%) and controls 264(82%) reported feeling cold as a symptom of malaria. Chill was reported as a symptom of malaria in most of the caretakers of both cases 93 (86.9%) and control 282 (88%). About three in every four of caretakers of both cases 81 (75.7%) and controls 243 (77%) reported headache as a symptom of malaria. 70 (65.4%) of caretakers of cases and 162 (51%) of caretakers of controls reported vomiting as a symptom of malaria. Sweating, vomiting, weakness, nausea, body ache, thirsty and diarrhea were reported as symptoms of malaria with a decreasing order of proportion of caretakers reporting. Accordingly diarrhea was the least reported as a symptom of malaria in both caretakers of cases 21 (20%) and controls 49 (15%).

Table 3 knowledge about symptoms of malaria, Adami Tulu district, 2014

Reported as symptoms of malaria	Cases(N=107)	Controls(N=321)
Fever	105(98.1%)	281(88%)
Feeling cold	95(88.8%)	264(82%)
Chills	93(86.9%)	282(88%)
Headache	81(75.7%)	243(77%)
Sweating	70(65.4%)	162(51%)
Vomiting	64(60%)	116(36%)
Weakness	58(54%)	124(39%)
Nausea	44(41%)	116(36%)
body ache	46(43%)	109(34%)
Thirsty	33(30%)	89(28%)
Diarrhea	21(20%)	49(15%)

Knowledge about the causes of malaria

About 9 in every ten of respondents of both cases 96(90%) and controls 299(93%) reported mosquito bite as a cause of malaria. Significant number of respondents reported that exposure to cold, hunger, eating sugarcane and maize stalk, exposure of dirty swampy water and drinking dirty water as a cause of malaria in both cases and controls (Table 4)

Table 4 knowledge about the causes of malaria, Adami Tulu District, 2014

Reported as a cause of malaria	Case(N=107)	Control(N=321)
Mosquito bite	96(90%)	299(93%)
Exposure to cold	32(30%)	20(6%)
hunger	22(21%)	59(18%)
Eating maize stalk	21(20%)	118(37%)
Eating sugarcane stalk	7(6.5%)	52(16%)
Exposure to dirty swampy water	10(9%)	49(15%)
Drinking dirty water	18(17%)	42(13%)

9.4 Malaria interventions

Overall, 219 (49.5%) of households owned at least one ITN. 59 (55.5%) of households of cases and 143 (47.7%) of households of controls owned at least one ITN. The overall ITN use in the under-five children was 150 (35%). It was 27 (25.2%) for cases and 123 (38.3%) for controls. Concerning IRS, overall 306 (71.5%) of the household had been sprayed. It was 77 (66.4%) for households of cases and 235 (73.2%) of households of controls (table 5).

Table 5 prevention of malaria, Adami Tulu District, 2014

Malaria intervention	Cases	Controls	Total
Percentage of households that have at least one ITN	59 (55.5%)	143 (47.7%)	219 (49.5%)
Percentage of under-five children who slept under ITN	27 (25.2%)	123 (38.3%)	150 (35%)
Percentage of households sprayed in the last 12 months	77 (66.4%)	235 (73.2%)	306 (71.5%)

9.5 Measures of Nutritional Status of children

The nutritional status of children is shown in table 6.

Overall 199 (46.5%) of under-five children were stunted and 107 (25%) severely stunted. Prevalence of stunting was 54 (50.5%) in cases and 145 (45.2%) in controls. 29 (27%) of cases and 78 (24.3%) of controls were severely stunted.

Using WHZ, overall, 49 (11.4%) of under-five children were wasted and 26 (6.1%) were severely wasted. Prevalence of wasting was 19 (17.8 %) in cases and 30 (9.3%) in controls. 14 (13.1%) of cases and 12(3.7%) of controls were severely wasted. Using MUACZ, overall 55 (12.9%) of under-five children were wasted and 13 (3%) were severely wasted. Prevalence of wasting was 26 (24.3%) in cases and 29 (9%) in controls. 7 (6.5%) of cases and 6 (1.9 %) of controls were severely wasted.

Overall about 85 (19.9%) of under-five children were underweight and 31 (7.2%) were severely underweight. Prevalence of underweight was 26 (24.3 %) in cases and 59 (18%) in controls. 14 (13%) of cases and 17(5.3%) of controls were severely underweight.

Table 6 Nutritional status of children in Adami Tulu district, 2014

Variable	Malaria case n=107	Control n=321
Wasting		
WHZ <- 3	14(13.1%)	12(3.7%)
-3 ≤ WHZ <-2	5(4.7%)	18(5.6%)
WHZ ≥-2	88(82.2%)	291(90.7%)
MUACZ <-3	7(6.5%)	6(1.9%)
-3 ≤MUACZ <-2	19(17.7%)	23(7.2%)
MUAC Z ≥-2	81(75.7%)	292(91%)
Stunting		
HAZ < -3	29(27.1%)	78(24.3%)
-3 ≤HAZ <-2	25(23.4%)	67(20.9%)
HAZ ≥-2	53(49.5)	176(54.8%)
Underweight		
WAZ <-3	14(13.1%)	17(5.3%)
-3 ≤ WAZ < -2	12(11.2%)	42(13.1%)
WAZ ≥ -2	81(75.7%)	262(81.6%)

Plasmodium species

Malaria diagnosis and plasmodium species differentiation was done by using microscope in about half of the cases (n=54) and RDT for the other half (n=53). *P.vivax* was the major *species* responsible for 58(54%) of malaria cases and *P.falciparum* was responsible for 42(39%) of controls. The rest 7(7%) were mixed infection (table7).

Table 7 Frequency of plasmodium species among under-five children, Adami Tulu district, 2014

Plasmodium species	Number	Percent
P.vivax	58	54%
P.falciparum	42	39%
Mixed	7	7%
Total	107	100%

9.6 Bivariate analysis on nutritional and other factors associated with malaria

This is shown in table 8.

Severe wasting (WHZ<-3), -3 ≤MUACZ <-2, sever underweight (WAZ<-3), sleeping under ITN of the child the last night, literacy and religion of respondent were significantly associated with malaria.

Children who slept under ITN on the last night were 46% less likely to have malaria than those slept without ITN (OR= 0.54 95% CI: 0.33, 0.89). Children with caretakers who had no formal education were 2.5 times more likely to have malarial attack than those with secondary education or above (OR=2.46 95% CI 1.11, 5.55).

Severely wasted children were 3.9 times more likely to be attacked by malaria than not wasted children (OR= 3.86, 95% CI: 1.72, 8.65). Children with MUACZ <-3 SD were 4 times more likely to be attacked by malaria than with MUACZ ≥-2 with (OR=4.21, 95% CI: 1.37, 12.86). while children with MUACZ between -2 and -3 SD were 3 times more likely to be attacked by malaria than MUACZ ≥-2 with (OR=2.98 ,95% CI: 1.55, 5.74), severely underweight children were 2.7 times more likely to be attacked by malaria than not underweight children (OR=2.66,95%CI:1.26,5.64).

Table 8 Bivariate analysis on nutritional and other factors associated with malaria in under-five children, Adami Tulu district, 2014.

Variable		Case n=107	Control n=321	Crude OR	95% CI	
					lower	upper
Wasting						
	WHZ <- 3	14(13.1%)	12(3.7%)	3.86	**1.72**	**8.65**
	-3 ≤ WHZ <-2	5(4.7%)	18(5.6%)	0.92	0.33	2.54
	WHZ ≥-2	88(82.2%)	291(90.7%)	1		
	MUACZ <-3	7(6.5%)	6(1.9%)	4.21	**1.37**	**12.86**
	-3 ≤MUACZ <-2	19(17.7%)	23(7.2%)	2.98	**1.55**	**5.74**
	MUAC Z ≥-2	81(75.7%)	292(91%)	1		
Stunting						
	HAZ < -3	29(27.1%)	78(24.3%)	1.23	0.73	2.09
	-3 ≤HAZ <-2	25(23.4%)	67(20.9%)	1.24	0.71	2.15
	HAZ ≥-2	53(49.5)	176(54.8%)	1		
Underweight						
	WAZ <-3	14(13.1%)	17(5.3%)	2.66	**1.26**	**5.64**
	-3 ≤ WAZ < -2	12(11.2%)	42(13.1%)	0.92	0.46	1.84
	WAZ ≥ -2	81(75.7%)	262(81.6%)	1		
Child age						
	6-24	50	116	1.55	0.99	2.41
	24-59	57	205			
Sex	**male**	70	179	1.50	0.95	2.37
	female	37	142			
Religion of respondent						
	Islam	71	256	0.40	0.18	0.91
	Orthodox	25	49	0.74	0.30	1.84
	protestant	11	16	1		
Residence						
	Urban	82(76.6%)	247(77%)	0.98	0.59	1.65
	Rural	25(23.4%)	74(23%)			
Indoor residual spray within last 12 month						
	Yes	71	235	0.72	0.45	1.16
	No	36	86	1		
Sleep under ITN last night						
	Yes	27	123	0.54	0.33	0.89
	No	80	198	1		
Literacy of respondent						
	No education	70	181	2.46	**1.11**	**5.55**
	Primary(1-8)	29	89	2.08	0.88	4.88
	≥ Secondary (≥9)	8	51	1		

9.6 Multivariate analysis on Nutritional and other Predictors of malaria in under-five children

This is shown in table 9.

In multivariate analysis, only those variables with <0.2 significance entered in to the model. The issue of collinearity was a concern because of the nature of anthropometric variables and that was checked using collinearity diagnostic and of course there was multi-collinearity among WAZ, WHZ and HAZ variables. Reduction was applied to alleviate the problem. WAZ was reduced from the model because WHZ is more important variable to show acute malnutrition than WAZ. After adjusted for possible confounders: WHZ<-3, -3≤MUAC<-2, literacy of respondent remained significant.

Severely wasted children were 3 times more likely to have malarial attack than not wasted children (adjusted OR=2.95, 95% CI: 1.14, 7.60). In addition Children with MUACZ between -2 and -3 SD were 3 times more likely to have malarial attack than MUACZ ≥-2 (adjusted OR =3.02 , 95% CI: 1.46, 6.25). Finally Children with caretakers who had no formal education were 3 times more likely to have malarial attack than those with secondary education or above (adjusted OR= 3.00, 95% CI: 1.27, 7.10)

Table 9 Multivariate Analysis- predictors of malaria in under-five children, Adami Tulu district, 2014

Factors	Cases n=107	Controls n=321	Crude OR	Adjusted OR	95% CI	
					Lower	upper
Child age (months)						
6-24	50	116	1.55	1.55	0.96	2.50
25-59	57	205	1	1		
Sex						
Male	70	179	1.55	1.51	0.93	2.47
Female	37	142	1	1		
Religion						
Islam	71	256	0.40	0.43	0.17	1.07
Orthodox	25	49	0.74	1.03	0.37	2.87
Protestant	11	16	1	1		
Sleep under ITN last night						
Yes	27	123	0.54	0.66	0.38	1.11
No	80	198	1	1		
Literacy of respondent						
No education	70	181	2.46	***3.00****	1.27	7.10
Primary(1-8)	29	89	2.08	2.42	0.96	6.06
Secondary(9-12)	8	51	1	1		
Wasting (SD)						
WHZ <-3	14(13.1%)	12(3.7%)	3.86	***2.95****	1.14	7.60
-3≤WHZ <-2	5(4.7%)	18(5.6%)	0.92	0.66	0.21	2.03
WHZ ≥-2	88(88.2%)	291(90%)	1	1		
MUAC(SD)						
MUACZ<-3	7(6.5%)	6(1.9%)	4.21	2.93	0.81	10.65
-3≤ MUACZ <-2	19(17.7%)	23(7.2%)	2.98	***3.02****	1.46	6.25
MUACZ ≥-2	81(75.7%)	292(90.9)	1	1		
Indoor residual Spraying Yes	71	235	0.72	0.64	0.37	1.12
No	36	86	1	1		

***** Indicates significant OR

10. Discussion

This study compared the prevalence of malnutrition in under-five children between malaria cases and controls so as to see the association between malnutrition and malaria. After controlling for possible confounders, there was a positive statistically significant association between wasting and malaria in under-five children. This was revealed as severely wasted children, based on WHZ, were 3 times more likely to have malarial attack than non-wasted children. Similarly children with moderate wasting, based on MUACZ, were 3 times more likely to have malarial attack than non-wasted. WAZ was not included in the final model because of collinearity but malaria was 2.7 times more likely in severely underweight children than non-underweight in bivariate analysis. The other factor which was independently associated with malaria in under-five children was caretaker/maternal education. Children with caretakers who had no formal education were 3 times more likely to have malarial attack than those with secondary education or above.

Our finding of increased odds of malaria in underweight children is consistent with the finding of a cross sectional study in northern Ghana with large sample size comprising 4000 children. This study showed positive association between underweight and Clinical malaria. Underweight children were 70% more likely to have clinical malaria than not-underweight (23). In addition, a study done in Vanuatu in a cohort of children revealed P.vivax was positively associated with underweight (24) . Similarly, a hospital based study in Gambia showed lower mean weight for age at admission for malaria patients compared to controls (25). This study compared the mean weight for age of hospitalized children with well children from other surveys. It showed lower mean WAZ for hospitalized children with malaria, cerebral malaria and other infectious diseases compared to well children. All of the above studies defined malaria based on fever and parasitemia which is similar with the case definition of our study

In contrary to our study, different studies showed no association between underweight and malaria (19, 20, 26) . A cross sectional study done on children in south-west Ethiopia found no association between underweight and malaria (19). Another cross sectional study done in Uganda revealed no significant association between malarial parasitemia and underweight (20). These two studies unlike our study defined malaria only based on parasitemia, not considering

clinical manifestation. This difference might be the possible explanation for the inconsistent finding. A study done in a cohort of children in rural Burkina Faso also found no association between underweight and malaria (26).

The increased odds of malarial attack in wasted children than non-wasted in our study is consistent with a case control study done in Nigeria which revealed high likelihood of malaria in acutely malnourished children than normal (30). Another study done in Democratic Republic of Congo also showed, children with severe protein energy malnutrition were at higher risk of clinical malaria (29). In this study, the risk of malaria during hospital stay was compared with nutritional status of children at admission. And the study revealed higher clinical malaria on children requiring therapeutic feeding with MUAC < 115mm. Similarly, a cross sectional study done in Rwanda showed, children with low MUAC were significantly associated with increased *P.falciparum* infection (34). In addition, a study done in Vanuatu, there was a positive relationship between P.vivax and wasting. Concerning the immune response of wasted children, a study done in *Papua* New Guinean revealed that humeral responses to specific malarial antigens were lowest in the wasted children (10).

A retrospective analysis of routine programme data on forty-eight nutritional rehabilitation centers in southern Ethiopia showed that 28% of malnourished children with fever (Temperature >37.5°C) were positive for malaria on RDT. In this study there was a significant positive association between malaria prevalence and increasing grades of malnutrition (31). Even though this did not compare malaria in malnourished and well nourished children, it revealed a very high prevalence of malaria as compared to the prevalence of malaria in children in southern Ethiopia (5). The other finding of this study was the increased prevalence of malaria along with the severity of malnutrition.

In the contrary to our study, a cohort study done in rural preschool children in Senegal showed wasted children were at a significantly lower risk of having malaria attack (22). However, in this study the prevalence of wasting was relatively low (3.1%). The study done in south west Ethiopia also found no association between wasting and malaria (16). In this study, although the total sample size is large (2410), only 7(3.1%) of wasted children were positive for malaria. A

study by Murry done in famine environments to evaluate the effect of re-feeding of severely malnourished individuals revealed outbreak of malaria after re-feeding (35). The Outbreak of malaria that occurred in malnourished children after re-feeding was probably because of relapse rather than new infection. Lack of nutrients essential for plasmodium growth like Para-amino benzoic acid, Iron in starved children could inhibit the multiplication of the parasite (35). Re-feeding of the already infected malnourished children provided important nutrients not only for the child but probably also for the plasmodium parasite.

Understanding how malnutrition is associated with infections in general is a very important step to understand how malnutrition is associated with malaria in particular. Malnutrition increases susceptibility to infection and infection, on the other hand, has adverse effect on nutritional status (8) . The reduced resistance to infection in malnourished children is mainly explained by the suppression of immunity in malnourished children. Malnutrition affects not only the humeral and cell mediated immunity but it also affect bactericidal activity of phagocytes and complement formation (8). There are evidences supporting the hypothesis that malnourished children have lower immunity against malaria parasite. A study done in Papua New Guinean revealed that humeral responses to malarial antigens were significantly lower in the wasted children than normal. The same study showed wasted children had more malarial attack than well-nourished children but the difference was not significant (10) . A study done in Senegal revealed lower level of specific IgG response in malnourished children than controls (22).

The answer for the question of the relationship between malnutrition and malaria: whether it is synergistic or antagonistic may not be straightforward. This is because there are many studies supporting both sides (10, 22, 30, 35). The difference in study design could be a possible explanation for the contrasting findings. When studies compare nutritional status in malaria patients and control groups, it‟s good to carefully look at who these control groups are. It‟s known that common childhood illnesses like pneumonia & diarrhea are highly associated with malnutrition. If such sick children are considered in the control group to compare them with malaria cases, this will distort the true association between malaria & malnutrition. In such studies if malnutrition is found to be less in malaria patients compared to the comparison group, we cannot conclude that malnutrition is protective against malaria. We can probably say

malnourished individuals are at higher risk of diseases like pneumonia or diarrhea than malaria. Therefore having healthy comparison group is a very important issue to see the relationship between malaria and malnutrition.

The other important reason for the conflicting finding can probably be due to the difference in the case definition of malaria; Malaria parasitemia only, Fever only or both fever and malaria parasitemia. Although fever is the most important symptom of malaria, fever is not specific for malaria, as it is a very common symptom of infectious diseases including upper respiratory tract infections (17). Although malnourished children are at higher risk of infection they may not have fever while infected because of poor immune response. Malaria parasitemia could be lower in severely malnourished individual as a result of poor multiplication of the parasite due to lack of nutrients essential for the multiplication or due to adverse environment in the human body associated with production of toxins in severely malnourished individual. However they are unable to clear the infection because of suppressed immunity and relapse of malaria probably occur when the conditions are favorable for the parasite (4). Therefore in our study the case definition for malaria included both fever and parasitemia which is in line with the national malaria guideline (17).

Another explanation for the controversy could be because most of the studies, including our study, did not control the effect of specific micronutrients deficiency on malaria morbidity. But this is very important as protein energy malnutrition occur usually together with micronutrient deficiency. And specific type of micronutrient deficiency matters on how malnutrition is associated with malaria.

Lack of formal education of caretakers was another factor positively associated with under-five malaria attack. This is consistence with studies done in rural Rwanda and Tanzania (34, 36). Education is the most important factor that influences mothers‟ knowledge and attitude about childhood diseases in general and malaria in particular.

11. Strengths and limitations of the study

Strength of the study

- ✓ Use of apparently healthy control is very important because, most common childhood diseases are associated with malnutrition and therefore it is difficult to demonstrate valid association between malaria and malnutrition if the controls are sick.
- ✓ Comparability of cases and controls for example in terms of age group and residence
- ✓ Use of anthropometric method to assess nutritional status (the major exposure variable) reduces the major biases of case-control study. Since the major exposure variables (wt, ht, MUAC) are assessed objectively they are unlikely to be affected by recall bias, selection and inter-viewer bias.

Limitations of the study

- ✓ Non random selection of cases may affect generalizability
- ✓ The effect of micronutrients not investigated.
- ✓ Information bias related to other variables (other than nutritional)

12. Conclusion and recommendation

12.1 Conclusion

- Acute malnutrition (Wasting) was an important factor positively associated with malarial attack in under-five children
- Severe underweight was also positively associated malarial attack in under-five children
- No association was found between malaria and stunting.
- Those children with uneducated caretakers were more likely to develop malarial attack.

12.2 Recommendation

1. For governmental & NGOs working on malaria

-Malaria control programmes should consider integrating nutritional interventions

2. For Health professionals

-Early detection and treatment of acute malnutrition

3. For Researchers: Further researches on the effect of malnutrition (that include micronutrient) on malarial morbidity is needed.

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15 Annexes

Annex 1: Participant Information sheet & Informed consent form

ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES, SHOOL OF PUBLIC HEALTH

Questionnaire designed to assess .the relationship between malaria and malnutrition among under-five children, Adami Tulu district, south-central Ethiopia

Questionnaire No: _____

Woreda: _____

Kebele _____

Name of the health center----------GOT……

Individual information sheet

Hello, my name is …… I work for an institution named Addis Ababa university school of Public Health. I am one of the data collectors on the study with the above topic. I would like you to cooperate in answering the questions that follows. The information you will provide contributes to measures that are taken to control malaria.

Any information you provide will be confidential. You have the right to not to participate in the study.

Are you willing to participate in the Study? Yes_____(continue) No_____ Thank you

Name of Interviewer: _____ Date: _ _/_ _/ _ _

Start time: _ _/_ _/ _ _ End time: _ _/_ _/ _ _

Interviewer agreement

„I certify that I have filled this questionnaire in accordance with the training I was given and instructions stated in it. I have confirmed that the information in it is correct.“

Signed_____ date _____

Date ----------/month----------/year----------

Name of data collector---------- signature----------

Interview date _ _/_ _/ _ _

Annex 2: Questionnaire

Section 1: Socio-demographic characteristics of the respondents

No.	Questions	Responses	Skip to
1	Sex of the respondent:	Male 1 Female 2	
2	What is your age in full years?	Year [_____]	
3	What is your place of residence (rural / urban)?	Rural 1 Urban 2	
4	What is your religion?	Islam 1 Orthodox Christian 2 Protestant Christian 3 Other (specify)_____88	
5	What is your ethnic group?	Oromo 1 Amhara 2 Gurage 3 Other (specify)_____88	
6	What is your current marital status?	Married 1 Never married (single) 2 Divorced 3 Widowed 4 Separated 5	
7	Can you read and write?	Yes 1 No 2……..	→9
8	If "**Yes**" to **Q8**, what is the highest level of school or grade you attended or completed?	Can only read and write _____ 1 Elementary school (1-4) ____ __ 2 Junior secondary school (5-8) __ 3 Senior secondary school (9-12)__ 4 Other (specify)_____ 88	

9	What is your relationship to the sick child?	Mother 1 Father 2 Brother 3 Sister 4 Others (specify)_____88	
10	Are both parents of the child alive? If No, which of the parents Died?	Yes 1 NO (specify) _____ 2	
11	What is your current main work/occupation? • ***Circle only one main answer***	Housewife _____ 1 Farmer _____ 2 Daily labourer _____ 3 Government/NGO employee ____ 4 Trader _____ 5 Other (specify)_____88	
12	How many people currently live in the household, including you and under-five children?	Total number of household members [____]	
13	How many children under-five currently live in the household?	Total number of under-five [____]	
14	What is the main material of the roof of house of the household?	Thatched 1 Corrugated iron 2 Other (Specify)_____88	
15	Does your household have: Electricity? A functional radio? A functional television? A functional telephone? A functional refrigerator?	**Yes No** Electricity……1 2 Functional RADIO……..1 2 Functional TELEVISION……..1 2 Functional TELEPHONE……..1 2 Functional REFRIGRATOR……..1 2	

	A functional Bicycle?	Bicycle…… 1 2	
16	What is your household average monthly income?	[____] Birr	
17	How far is this health care from your home?	Less than 30 minutes walk 1 30 minutes – under 1 hour walk 2 1 hour to under 2 hours walk 3 2 hours to under 3 hours walk 4 3 or more hours 5 Don't know 98	

Section 2: Malaria general knowledge, its prevention and treatment

No.	Questions	Responses			Skip to
18	Do you consider malaria a major health problem in your community?	Yes 1 No 2			
19	What are the main signs and symptoms of malaria? • ***Multiple responses possible and circle all responses that apply*** • ***Probe for possible answers (Anything else?)***		yes	**No**	
		Fever	1	**2**	
		Feeling cold	1	2	
		Chills or shivering	1	2	
		Sweating	1	2	
		Headache	1	2	
		Nausea	1	2	
		Vomiting	1	2	
		Loss of appetite	1	2	
		Bitterness in the mouth	1	2	
		Body weakness/tiredness	1	2	
		Body ache/joint pain	1	2	
		Thirsty	1	2	

		Diarrhea Don't know Other (specify)_____88	1 1	2 2	
20	In your opinion, what causes malaria? • ***Multiple responses possible and circle all responses that apply*** • ***Probe for possible answers (Anything else?)***	Mosquito bite 1 Eating immature sugarcane 2 Eating maize stalk 3 Hunger (empty stomach) 4 Exposure to cold or changing weather 5 Drinking dirty water 6 Witchcraft 7 Exposure to dirty swampy areas 8 Don‟t know 98 Other (specify) _____ 88			
21	For which group of the population do you think malaria is more serious? • ***Multiple responses possible and circle all responses that apply*** • ***Probe for possible answers (Anything else?)***	Adults 1 Children under five years of age 2 Children over five years of age 3 Pregnant women 4 Elderly 5 Equally serious for all 6 Don't know 98			
22	Malaria is a treatable disease	True 1 False 2			

		Don't know or not sure 98	
23	Waiting too long to get treatment increases ones chances of dying from malaria	True 1 False 2 Don't know or not sure 98	
24	Children under five are more likely to die than other household members if they are not taken to a health facility as soon as they experience fever	True 1 False 2 Don't know or not sure 98	
25	Malaria is a preventable disease	True 1 False 2 Don't know or not sure 98	
26	How can someone protect themselves against malaria? • ***Multiple responses possible and circle all responses that apply*** • ***Probe for possible answers (Anything else?)***	To sleep under mosquito net/ITNs 1 To spray house with insecticide (DDT) 2 Smoking (burn leaves/cow dung) nearby the house 3 Drain mosquito breeding sites around the house 4 Window screening 5 Eat garlic 6 Drink alcohol 7 Other (specify)_____ 88 Don't know 98	
27	Sleeping under mosquito net (ITNs) every night prevents malaria	True 1 False 2 Don't know or not sure 98	
28	Does your household currently have any mosquito net that can be used while sleeping?	Yes 1 No 2……..	→33
29	How many mosquito nets do you		

	currently have [both used and unused]?	[_____]	
30	How many of the nets the household has are **currently used** by household members while sleeping?	[_____]	
31	How frequently did the Sick CHILD sleep under mosquito net/ITNs within the last 15 days?	All nights 1 Almost all nights 2 Sometimes 3 Only few nights 4 None of the nights 5	
32	Did the Sick CHILD sleep under mosquito net/ITNs last Night?	Yes 1 No 2	
33	Did the child experiences fever in the last 48 hours?	Yes 1 No 2	
34	When was the last time the child experienced fever?(other than current fever, if any),write 00 if there is no previous fever history.	[_____]	
35	Did the child get malaria illness in the past 12 month?	Yes 1 No 2…….	→ 38
36	How many times the child suffered from malaria in the past 12 month?	[_____]	
37	Did the child get any anti malaria treatment in the past 12 months?	Yes 1 No 2	

38	Indoor residual spray is a chemical that is sprayed on the walls to kill mosquitoes that cause malaria	True 1 False 2 Don't know or not sure 98	
39	At any time in the past 12 months, has anyone sprayed the interior walls of your dwelling against mosquitoes?	Yes 1 No 2…… Don't know 98	→41 section 3
40	How many months ago was the house sprayed against mosquitoes? IF LESS THAN ONE MONTH, RECORD 00 MONTHS AGO.	[_____]MONTHS AGO	

Section 3: Anthropometric and breast feeding information of the child

No	Question	Response categories	skip
41	What is the age of the child?	Birth date___ ___ ____ (DD/MM/yyyy) OR Age: __Years ___ months and ____days	
42	What is the sex of the child?	Male ……1 Female……..2	
43	Did you (mother) ever breasted fed the child?	YES . . . . . 1 NO . . . . . 2……	→50
44	Are you (mother) still breast feeding?	Yes……1 No……2	
45	In the first three days after Delivery, was the child given Anything to drink other than	YES . . . . . 1 NO . . . . . 2……	43

	Breast milk		
46	What was given to the child? Record all liquids mentioned	MILK (OTHER THAN BREAST MILK) . . . . …..1 PLAIN WATER . . . . . 2 Butter …… 3 Other(specify)…… 4	
47	For how long did the child exclusively breast fed?	_____ months	
48	For how long did the child breast fed totally?	_____ months	
49	Weight	…… kg	
50	Height	……..cm	
51	MUAC	……..cm	

Section 4: laboratory result and Fever record

No	Questions	Response category	skip
52	Is blood film currently done for the child to test for malaria parasite?	YES 1 NO 2 ……..	**56**
53	What diagnostic tool used to test blood film of the sick for malaria?	Microscopy 1 RDT 2	
54	What was the laboratory test result of the sick child?	Positive 1 Negative 2……..	**56**

55	What was the Plasmodium species responsible for the child illness?	P. falciparum 1 P.vivax 2 Mixed of both 3 Other (specify)…..	
56	What is the recorded temperature of the child?	_____	

Thank you for all

Annex 3: Afan Oromo (local language) version of Participant Information sheet & Informed consent form

Waraaqa Oddeffaannoo Hirmaattoota FI Foormii Heeyaama

Yuunivaarsitii Finfinnee, koolleejjii Saayinsii fayyaa, Mana baarumsa Fayyaa Hawasaa

Gaaffiiwwaan walitti dhufeenya busaa fi hirinaa nyaata ijjollee waggaa shaanii gadii qoorachuuf qoopha‟‟ee, Aanaa Adaami Tullu, Shawaa bahaa, Ithiyoopiyaa
Lakk. Gafffii:_____

Aanaa: _____

Gandaa _____garee----------gooxii---------- Maqaa buufata fayyaa----------

Waraaqa oddeffaannoo dhunfaa

Helloo maqaan kiyyaa …… jeedhaama. Dhaabbata yuunivaarsitii Finfinnee, Koolleejjii Saayinsii Fayyaa jeedhamu keessaan hoojjeedha. Gaaffille armaan gadii deebisuuf akkaa na gargaartan kabaajan isiin gafaadha. Oddeffannon isiin naf keenitaan dhukkubba busaa ittisuuf keessatti ga‟‟ee gudda qaba

Oddeffaannoo nuf keenitaan maartinuu dhimma qooraannoo alaa waan biraaf hin oluu. Qoo‟‟annoo kaana kessatti hirmaachuu dhisuuf mirga qabdu.

Itti hirmaachuuf fedhii qabdu? Eyyee_____(Itti fuufi) Lakkii_____ Galaatoma (dhaabi)

Maqaa nama gaaffii gaafatee : _____ guyya: _ _/_ _/ _ _

Yeeroo jalqabaa: _ _/_ _/ _ _ yeeroo xumura: _ _/_ _/ _ _

Waligaltee nama gaaffii gaafatee

Waraaqa gaaffii kaana akkaa qaajeelfaama fi leenjii keenameetti guutu kiyyaa ragaan bahaadha. Oddeeffaannon as keessa jiru sirrii ta‟‟uu isaa ragaan bahaa

Mallattoo_____ guyyaa_____

Annex 4: Afan Oromo (local language) version of questionnaire

Gaaffilee qorannoo

Kutaa1: Odeeffannoo haala jireenya hirmaattotaa

T.L	Gaaffilee	Deebii	darbi
1	Saala hirmaataa	Dhiira 1 Dhalaa 2	
2	Umuriin kee waggaadhan meeqa(hirmaata)?	waggaa [_____]	
3	Eessa jiraatta (baadiyyaa/magaalaa (rural / urban)?	Baadiyyaa 1 Magaalaa 2	
4	Amantaankee maali?	islaama 1 ortoodoksii 2 protestaantii 3 Kan biro(caqasi)----------88	
5	Sabinni kee maali?	Oromoo 1 Amaara 2 Guraagee 3 Kan biro (caqasi)_____88	
6	Haalli Gaa‟ila kee maali?	Kan heerumte /fuudhe 1 Kan hin heerumne/ hin fuune 2 Kan hike/ hiikte 3 Kan haati mana ykn abbaan manaa jalaa du‟e 4	

		Kan adda jiraatan 5	
7	Dubbisuu fi barreessuu ni dandeessaa?	Eyyee 1 Miti 2	→9
8	Yoo deebin gaaffii lakk. 7-eyyee ta‟e kutaa meeqa baratte?	Dubbisuu fi barreessuu qofa_____ 1 Sadarkaa tokkoffaa marsaa duraa(1-4) ____ __ 2 Sadarkaa tokkoffaa marsaa lammaffaa (5-8) __ 3 Sadarkaa lammaffaa (9-12)__ 4 Kan biro(caqasi)_____ 88	
9	Walitti dhuufeenyi kee fi mucaa dhukkubsatu kanaa maali?	Haadha 1 Abbaa 2 Obboleessa 3 Obboleettii 4 Kan biroo (caqasi)_____88	
10	Abbaa fi haati mucaa jiruu? Miti yo ta’e kamtu jalaa du’e?	Eyyee _____ 1 Miti (ibsi) _____ 2	
11	• Hojiin/hojjaankee kan ammaa maali? • ***Deebii sirri tokko qafa filadhu***	Haadha warraa_____ 1 Qotee bulaa _____ 2 Dafqaan bulaa_____ 3 Hojjetaa mootummaaa/Miti mootummaaa____ 4 Daldalaa _____ 5 Kanbiroo(caqasi)_____88	
12	Lakkofsi maatii kee ijoollee umurii waggaa shanii gadii	Lakkofsa miseenota maatii[____]	

	dabalate meeqa?		
13	Maatii kee keessa ijoollee umurii waggaa shanii gadi meeqatu jiru?	Baayina ijoollee waggaa shanii gadi [____]	
14	Baaxiin mana keessani maal irraa hojjatame?	Mana citaa 1 Qorqorroo 2 Kan biroo(caqasi)_____88	
15	Mana keessan keessaa? Elektirikii qabduu? Raadiyoo kan hojeetu? Teleevesiyoona kan hojeetu? Bilbila hojeetu? Dilallessituu/refregiratarii hojeetuu? Biskiliittii hojeetu?	**Eyyee Miti** Elektirikii ……1 2 Raadiyoo ……..1 2 Teleevesiyoona ……..1 2 Bilbila ……..1 2 Dilallessituu/refregiratarii ……..1 2 Biskiliittii …… 1 2	
16	Galiin maatiike ji'atti giddugaalesaan meeqa?	[____] Birr	
17	Manni yaalaa kun hammam sirraa fagaata?	Deemsa daqiiqaa 30 gadi 1 Deemsa daqiiqaa hanga sa'a tokko 2 Sa'a tokko hanga sa'a lamaa 3 Sa'a lamaa hanga sa'a sadi 4 Sa'a sadi fi isaa ol 5 Hin beeku 98	

Kutaa2: beekumsa walii gala waa'ee busaa, ittisa isaa fi yaala isaa

T.L	Gaaffilee	Deebii			Darbi
18	Rakkoon Busaa fayyaa guddaa naannoo kooti jettee ni yaaddaa?	Eyyee 1 Miti 2			
19	Mallattooleen busaa maal faadha? • ***Debin kee itti marii (Deebii baay'ee deebisuu dandeessaa. Deebii biroof kakaasii***		Eyyee	**Miti**	
		Dhaqna gubaa	1	**2**	
		Qorrisiisuu	1	2	
		Hollachiisuu	1	2	
		dafqisiisuu	1	2	
		mataa bowwuu	1	2	
		garaa keessa ol godhuu	1	2	
		balaqqamsiisuu	1	2	
		fedha nyaataa dhabuu	1	2	
		Afaan hadheessuu	1	2	
		Dadhabbii qaamaa	1	2	
		Dhukkubbii qaamaa ykn buusaa	1	2	
		dheebuu	1	2	
		garaa baasaa/kaasaa	1	2	
		hin beeku	1	2	
		kan biroo (caqasi)_____88			
20	Akka yaada keetti busaa maaltu fidaa? • ***Deebii baayyee deebisuu dandeessaa; deebii keetti mari. Deebii biroof kakaasii (Kan biroo?)***	Ciniinnaa bookee busaan 1 Agadaa xobbee nyaachuun 2 Hundee boqolloo nyaachuun 3 beelaan(garaa duwwaa) 4 qilleensa qorraan 5 bishaan booruu dhugun 6 budaa/falfaaltuu 7 bakkaa kosiittii saxila ba"uun8			

		hin beeku 98 kan biroo (caqasi) _____ 88	
21	Busaan nama kamiif irra hamaadha? • ***Deebii baayyee deebisuu dandeessaa; deebii keetti mari. Deebii biroof kakaasii (kan biroo?)***	Gaʺæssa 1 Ijoollee waggaa shanii gadii 2 Ijoollee waggaa shanii olii 3 Dubartii ulfaa 4 Jaarsolii 5 Hundumaafuu wal qixa hamaadha 6 Hin beeku 98	
22	Busaan dhibee yaalaa qabuudha	Dhugaa 1 Soba 2 Hin beeku 98	
23	Yaala malee turuun busaan duʺuuf nama saaxila	Dhugaa 1 Soba 2 Hin beeku 98	
24	Ijoolleen waggaa shanii gadii yoo dafanii akka qaamaa gubaan isaan jalqabeen mana yaalaatti hin geessaman yoo taʺe namota biroo caalaa carraa duʺuu guddaa qabu.	Dhugaa 1 Soba 2 Hin beeku 98	
25	Busaan dhukkuba ittisuun dandaaʺamuudha	Dhugaa 1 Soba 2 Hin beeku 98	
26	Akkamitti busaarraa of eeguun dandaaʺama? • ***Deebii baayyee deebisuu dandeessaa; deebii keetti mari. Deebii biroof kakaasii***	Saaphana farraa bookee busaa cupamee jala rafun1 Farra ilbiisaa manatti biifuun) 2 Manatti haarsuun(baala /dikee looniiguggubuun)3 Bakka wal hormaata bookee busaa gogsuun4 Foddaa ittistuu 5 Qullubbii adii nyaachuun 6	

	(kan biroo?)	Alkoolii dhuguun 7 Kan biroo(caqasi)_____ 88 Hin beeku 98	
27	Saaphana farraa bookee busaa cuphamee jala halkan hunda rafuun busaa ni ittisa	Dhugaa 1 Soba 2 Hin beeku 98	
28	Maatii kee yeroo ammaa Saaphana bookee busaa jala rafan ni qabuu?	Eeyyee 1 Miti 2……..	→33
29	Saaphana bookee busaa meeqa qabdu/ jira [kan itti fayyadamtani fi hin fayyaadamin dabalatee]?	[_____]	
30	Saaphana bookee busaa qabdan keessa meeqatu tajaajilaaf oolaa jira/ meeqatu jala rafaamaa jira?	[_____]	
31	Daa'imn dhukkubsatu kun yeroo meeqaaf Saaphana bookee busaa jala guyyoota kudha shanan darbaniif rafe ykn rafte?	Halkan hudamaaf 1 Halkan hudamaaf jechuun ni dandaa'ama 2 Yeroo tokko tokkoof 3 Halkan muraasa 4 Rafee hin beeku 5	
32	Daa'imi kun halkan darbe Saapana bookee busaa jala rafeeraa?	Eyyee 1 Miti 2	
33	Daa'imni kun guyyaa lamaan darban keessa Dhaqna gubaa qaba turee?	Eyyee 1 Miti 2	
34	Yoomi kan Daa'imi kun Dhaqna gubaa qabu (isa ammaa kana malee) ,kanan dura dhaqna guba	[_____]	

	hin qabu yoo ta'ee '00' guutii		
35	Ji'oota 12'n darban keessa buseen daa'ima kana qabee turee the past 12 month?	Eyyee 1 Miti 2……	→ 38
36	Ala meeqa kan busaan daa'ima kan ji'oota 12'n darban keessa qabe?	[_____]	
37	Ji'oota 12'n darban keessa daa'mi kun qoricha busaa fudhateeraa?	Eyyee 1, yeeroo meeqa-----? Miti 2	
38	Farri bookee busaa manatti biifamu keemikaala dagalee manatti biifamu ta'ee, bookee busaa ajjeesuuf oola.	Dhugaa 1 Soba 2 Hin beeku 98	
39	Ji'a 12'n darban keessa dagaleen mana keessani farra bookee busaan biifameeraa?	Eyyee 1 Miti 2…… Hin beeku 98	→41 section 3
40	Ji'a meeqa manni keesssan erga farra bookee busaan biifamee? Yoo ji'a tokko gad ta'e, ji'a '00' jedhi katabi.	[_____]ji'a dura	

Kutaa 3: Odeeffannoo antrooppomeetrii fi harma hodhuu daa'imaa

T.L	Gaaffilee	Deebii gareen	skip
41	Umuriin daa'ima kanaa meeqaa?	Guyyaa dhalootaa___ ___ ____ (GG/JJ/WWW) ykn	

		umurii : __waggaa ___ ji'a fi ____guyyoota	
42	Saala daa'imaa?	Dhiira ……1 Dhalaa ……..2	
43	Daa'imni kun harma haadhaa hodhee beekaa?	Eyyee . . . . . 1 Miti. . . . . 2……	→50
44	Ammaa hoosisaa jirtaa? (Haadha yoo taate)	Eyyee ……1 Miti ……2	
45	Guyyoota sadan jalqaba mucaan dhalatee wanta dhugamu harma haadhaan ala mucaaf laattaniittuu	Eyyee . . . . . 1 Miti. . . . . 2……	48
46	Me maalfaatu kennameef? Dhangala'a kennameef hunda katabi	Aannan (kan harma haadhaan ala). . …..1 Bishaan . . . . . ……2 Dhadhaa …… 3 Kan biroo (caqasi)…… 4	
47	Hammamiif kan Daa'imni kun harma haadhaa duwwaa hodhe/te?	_____ ji'oota	
48	Wali gala Daa'imni kun Hammamiif harma haadhaa hodhe/te?	_____ ji'oota	
49	Ulfaatina	…… kg	
50	Dheerina	……cm	
51	Naannawwaa giduu hirree daa'imaa (NGH)/MUAC	……cm	

Kutaa 4: bu'aawwan laboraatorii fi galmee ho'ina qaamaa

T.L	Gaaffilee	Deebii gareen	darbi
52	Qorannoo dhiigaa maxxantuu pilaasmoodiyeemii dhiiga keessa qorachuuf godhameeraa?	Eyyee 1 Miti 2 …….	**56**
53	Meeshaan qorannoo sun maaliidha?	mikiroskoppii 1 RDT 2	
54	Bu'aan qorannoo dhiigaa daa'ima dhukkubsataa/tu maal ture?	Positive 1 Negative 2……..	**56**
55	Sanyiin ykn gosti maxxantuu plaasmoodiyeemii dhukkuba mucaatti fiddee maal?	P. falsiifaramii 1 P.vivaaksii 2 Lamaanuu 3 Other (specify)…..	
56	Hammii ho'ina qaamaa daa'ima dhukkubsataa/tu galmeeffame meeqaa?	_____	

Galatoomaa/ ulfaadhaa!!!

CURRICULUM VITAE (CV)

1. CV of Principal Investigator

Personal Information

Name: - Dr. Bilal Shikur

Sex: - Male

Address: - Addis Ababa, Ethiopia
Kolfe Keranio sub-city
Tel: - +251911475375
Email: - lebiluka@yahoo.com
P.O Box: - 102code1056, Addis Ababa, Ethiopia

Date of birth: - 1, October 1986
Place of birth: - Addis Ababa, Ethiopia
Nationality: - Ethiopian
Marital Status: - Married

Educational Background

Type of Education	**Educational Institution**	**Location**	**Years Attended**	**Certificates Awarded**
Secondary Education	Dilachin	Addis Ababa, Ethiopia	September 2001-July 2003 G.C	Ethiopian General Secondary Education Certificate
Preparatory Education	Medhaniyalem	Addis Ababa, Ethiopia	September 2003-July 2005 G.C	Ethiopian Higher Education Entrance Certificate
Higher Education	Addis Ababa University (AAU), School of Medicine	Addis Ababa, Ethiopia	January 2006-September 2011	Medical Degree (MD)

Merits Received

➔ Ethiopian General Secondary Education Certificate with 4.00 GPA (9As)

➔ Ethiopian Higher Education Entrance Certificate with Great Distinction

Work Experience

Addis Ababa University, School of Public Health (SPH), Addis Ababa, Ethiopia from Sept 2011

Lecturer (lecture undergraduate medical students): Public Health nutrition
Member of the managing committee of ***'Butajira rural Demographic Surveillance Site'***
MPH fellow at AAU, SPH (Epidemiology & Biostatistics specialty track)

Medco Bio-medical College, Addis Ababa, Ethiopia from September2008

Lecturer and clinical mentor (pediatrics, Epidemiology)

Africa Medical College (pediatrics) **from September 2010**

Betel Medical College(

(Medical ethics and law for medical students) from November 2013

Tropical college of medicine not currently

Addis Ababa medical college not currently

Trainings taken, Conferences attended

- MDR/XDR TB management training from Ethiopian Society of General Medical Practitioners and USAID, September 2010.
- PMTCT training from AAU & John Hopkins University/TSEHAI project, March, 2011.
- ART & HIV care training from AAU School of Medicine & WHO, August 2011.
- Emergency Medicine training for interns from AAU, September, 2010.
- BPR & Government policy training from Ministry of Health, September, 2011.
- TOT on Application of Behavior Change Communication Strategies for HIV/AIDS, by AAU-MARCH Project, Johns Hopkins University Bloomberg School of Public Health & the US CDC.

-Training on DHS

Language

Language	**Speak**	**Write**	**Read**	**Understand**
English	Excellent	Excellent	Excellent	Excellent
Amharic	Excellent	Excellent	Excellent	Excellent
Arabic	Fair	Excellent	Excellent	Fair

Skills, Interests, Hobbies

- Know how on statistical software packages (SPSS, EPI INFO, WHO-Anthro, ENA-SMART, OPEN EPI, open code, STATA)
- Positive attitude
- Planning and Organizing
- reading
- Team leadership
- Good communication skills
- IT know how
- Public speech

Extracurricular Activities

- I was an active member & coordinator of the activities of EMSA (Ethiopian Medical Students Association) student led and legally licensed and registered organization.
- Helping students who have financial and psychological problem.

Professional Associations Membership

- Ethiopian Medical Association (EMA)
- Ethiopian Society of General Medical Practitioners
- Ethiopian Public Health Association (EPHA)

Future Plan and Interests

- To upgrade my level of education to the subsequent higher levels.
- To be a distinguished health researcher and professional.

Attestation

- Dr. Wakgari Deressa, Dean of the School of Public Health at AAU. (*deressaw@gmail.com*)
- Prof. Getnet Mitike, AAU, and SPH (*getnetmk@gmail.com Tel no: 0911245861*)
- I certify that the information given above is true & correct to the best of my knowledge.

Name: - Bilal Shikur, September 2013

2. CURRICULUM VITAE (CV) of advisor

Wakgari Deressa, BSc, MPH, PhD.
Associate Professor, School of Public Health, Addis Ababa University, Ethiopia

Personal Data

Name Wakgari Deressa Amente
Sex: Male
Date of Birth: 10 November 1969
Contact Address: Cell phone: +251-911-483714, Office phone: +251-11-515 77 01
Fax: +251-11-5517701, P. O. Box 6850
Email: deressaw@yahoo.com; deressaw@gmail.com
Addis Ababa, Ethiopia

Honors/Awards

- **Gold Medal and Certificate:** Young Public Health Research Award of the Ethiopian Public Health Association for outstanding achievements in conducting and promoting public health research in Ethiopia. October 2007.
- **Certificate of Recognition:** Ethiopian Public Health Association, for dedicated service as executive board member and vice president of the Association from 2008-2013. March 2013.
- **Certificate of Appreciation:** Ethiopian Public Health Association, for outstanding service during the 13th World Congress on Public Health, held in Addis Ababa in April 2012.

Education

- **PhD** Degree in Public Health, 2007, Addis Ababa University, Ethiopia
- **MPH** (Master of Public Health) Degree, 2000, Addis Ababa University, Ethiopia
- **BSc** Degree in Biology, 1989, Addis Ababa University, Ethiopia

Recent Work Experience

- **February 07, 2013 - present**
  - **Dean**, School of Public Health, College of Health Sciences, Addis Ababa University (AAU)
- **December 23, 2011 – present**
  - **Associate Professor**, Department of Epidemiology and Biostatistics, School of Public Health, Addis Ababa University (AAU), Addis Ababa, Ethiopia.
- **August 10, 2010 – May 30, 2012**
  - **Head,** Department of Epidemiology and Biostatistics, School of Public Health, AAU, Ethiopia.
- **October 11, 2005 – December 22, 2011**
  - **Assistant Professor**, Department of Epidemiology and Biostatistics, School of Public Health, AAU, Ethiopia.
- **January 15, 2008 – December 30, 2009**
  - **Assistant Dean for Undergraduate Program,** Faculty of Medicine, AAU, Ethiopia.
- **September 2007 – August 09, 2010**
  - **Post-graduate Program Coordinator**, School of Public Health, AAU, Ethiopia.

Other Experience and Professional Memberships

- **Feb. 2013 - Present:** Senate member of the Addis Ababa University
- **Feb. 2013 - present:** Member of the Academic Commission of the College of Health Sciences (AAU)
- **2008-2010:** Executive Board Member, Ethiopian Public Health Association
- **2010-2013:** Vice President of the Ethiopian Public Health Association
- **2005-Present**: Member, Ethiopian Malaria Control Professionals Association
- **2007-Present:** Member, Coalition against Malaria in Ethiopia
- **2011-Present:** Member, National Committee for Certification of Dracunculiasis Eradication in Ethiopia
- **2005-2007:** Member, Technical Review Panel for Global Fund (malaria), FMOH
- **2002-Present:** Member, Ethiopian Medical Association
- **2000-Present**: Life member, Ethiopian Public Health Association, which is the leading professional association engaged in promoting and supporting the growth of the public health profession through advocacy and dissemination of evidences to support positive policy development.

Teaching Experience

- Basic Biostatistics for both undergraduate and graduate programmes
- Principles of Epidemiology for graduate programs
- Advanced Biostatistics for postgraduate program
- Rural Community Health Training Program (RCHTP)
- Research Methodology for undergraduate and graduate programs
- Qualitative Research Methods for postgraduate program
- Leadership Strategic Information Training Program (LSI)
- Research and thesis advisor for undergraduate, MPH/MSc and PhD students in Public Health and Biomedical Sciences

Recent Peer Reviewed Publications

1. Sena L, **Deressa W** and Ali A. Predictors of long-lasting insecticide-treated bed net ownership and utilization: evidence from community-based cross-sectional comparative study, Southwest Ethiopia. *Malaria Journal* 2013, **12**:406.

2. Woyessa A, **Deressa W**, Ali A and Lindtjørn B. Evaluation of CareStart™ malaria Pf/Pv combo test for *Plasmodium falciparum* and *Plasmodium vivax* malaria diagnosis in Butajira area, south-central Ethiopia. *Malaria Journal* 2013; **12**:218.

3. Dori GU, **Deressa W**, Esposito F, Habluetzel A. Perceptions and practices of the Konso community (South-west Ethiopia) relating to malaria: implications for control. *Malaria World Journal* 2012; **3**:9.

4. Etana B, **Deressa W**. Factors associated with complete immunization coverage in children 12-23 months in Ambo Woreda, central Ethiopia. *BMC Public Health* 2012; **12**:566.

5. Jima D, Wondabeku M, Alemu A, Tefera A, Awei N, **Deressa W**, et al. Analysis of malaria surveillance data in Ethiopia: what can be learned from the integrated disease surveillance and response system? *Malaria Journal* 2012; **11**:330.

6. Bekele D, Belyhun Y, Petros B, **Deressa W**. Assessment of the effect of insecticide-treated nets and indoor residual spraying for malaria control in three rural kebeles of Adami Tulu District, South-central Ethiopia. *Malaria Journal* 2012; **11**:127.

7. **Deressa W**, Azazh A. Attitudes of undergraduate medical students of Addis Ababa University towards medical practice and migration, Ethiopia. *BMC Medical Education* 2012; **12**:68.

8. Woyessa A, **Deressa W**, Ali A, Lindtjørn B. Prevalence of malaria infection in Butajira area, south-central Ethiopia. *Malaria Journal* 2012; **11**:84.

9. **Deressa W**, Fentie G, Girma S, Reithinger R. Ownership and use of insecticide-treated nets in Oromia and Amhara Regional States of Ethiopia two years after a nationwide campaign. *Tropical Medicine and International Health* 2011; 16(12):1552-1561.

10. **Deressa W**, Azazh A. Substance use and its predictors among undergraduate medical students of Addis Ababa University in Ethiopia. *BMC Public Health* 2011; 11:660.

11. Mitike G, **Deressa W**. Prevalence and associated factors of female genital mutilation among Somali refugees in Eastern Ethiopia: a cross-sectional study. *BMC Public Health* 2009; 9:264.

12. **Deressa W**, Ali A. Malaria-related perceptions and practices of women with children under the age of five years in rural Ethiopia. *BMC Public Health* 2009; 9:259.

13. Belay M, **Deressa W**. Use of insecticide treated nets by pregnant women and associated factors in a predominantly rural population in northern Ethiopia. *Tropical Medicine and International Health* 2008; 13(10):1303-1313.

14. **Deressa W**. Treatment-seeking behaviour for febrile illness in an area of seasonal malaria transmission in rural Ethiopia. *Malaria Journal* 2007; 6:49.

15. **Deressa W**, Ali A, Berhane Y. Maternal responses to childhood febrile illnesses in an area of seasonal malaria transmission in rural Ethiopia. *Acta Tropica* 2007; 102(1):1-9.

16. **Deressa W**, Ali A, Berhane Y. Household and socio-economic factors associated with childhood febrile illnesses and treatment seeking behaviour in an area of epidemic malaria in rural Ethiopia. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 2007; 101(9):939-947.

17. **Deressa W**, Ali A, Hailemariam D. Malaria-related health-seeking behaviour and challenges for care providers in rural Ethiopia: implications for control. *Journal of Biosocial Science* 2008; 40(1):115-135.

18. **Deressa W**, Hailemariam D, Ali A. Economic costs of epidemic malaria to households in rural Ethiopia. *Tropical Medicine and International Health*. 2007; 12(10):1148-1156.

Research Grant Awards

 Collaborated with Centre for International Health at the University of Bergen in Norway in developing a research project entitled "Combining indoor residual spraying and long-lasting insecticidal nets for preventing malaria: Cluster Randomized Trial in Ethiopia" (2012-2016), funded by the Research Council of Norway (Research Project – GLOBVAC), Application Number: ES498076, Project Number: 220554. The study protocol has been approved by the Ethiopian Ministry of Science and Technology to be conducted in Adami Tulu woreda, East Shewa Zone, Oromia (2013-2016)**;** ***New project***

 Collaborated with Nottingham University in UK and developed a research project entitled "A pilot study to develop a point of care diagnostic assay for malaria suitable for use in adults". The study protocol has been approved by the Ethiopian Ministry of Science and Technology to be conducted in Adami Tulu woreda, East Shewa Zone, Oromia, in July-August 2012. ***New project***

 In collaboration with the Nottingham University in UK, developed a research project entitled "Concerns about HIV testing in delaying early presentation and treatment of malaria in Adami Tulu woreda, Ethiopia" to be conducted soon. ***New project***

 NUFU Project on "Ethiopian Malaria Prediction System" from 2007-2011 by Centre for International Health at Bergen University (Norway) (http://emaps.uib.no). 3.5 million NOK. Project Coordinator on the Ethiopian side. ***Completed***

 WHO/TDR Research Training Grant, USD $10,000.00, for specialized training abroad to acquire skills necessary for PhD training on a topic entitled ***"Malaria in Rural Ethiopia: Household Response, Economic and Demographic Impact Study"***. 2004. ID No. A30980. Principal Investigator. ***Completed***

 WHO/AFRO operational research grant, USD $11,300.00 on a topic entitled **"*Health Seeking Behaviour and Home Management of Malaria among Under Five Children in Adami Tulu District, Ethiopia*"**. 2003. Principal Investigator. ***Completed***

Declaration

I the undersigned, declare that this thesis is my original work, has never been presented in this or any other university, and that all the resources and materials used for the thesis development, have been acknowledged as complete references.

Name: Bilal Shikur

Signature: _____

Date of submission: _____

This thesis work has been submitted for examination with our approval as university primary advisor.

Name: Dr. Wakgari Deressa

Signature: _____

Date: _____