COLLEGE OF HEALTH SCIENCES

SCHOOL OF NURSING AND MIDWIFERY

POSTGRADUATE PROGRAM

TREND AND DETERMINANTS OF TREATMENT OUTCOME OF SEVERE MALARIA AMONG UNDER-FIVE CHILDREN ADMITTED IN KARAT PRIMARY HOSPITAL, KONSO ZONE, SOUTHWEST ETHIOPIA, 2021: RETROSPECTIVE CROSS-SECTIONAL STUDY

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A THESIS TO BE SUBMITTED TO THE SCHOOL OF NURSING AND MIDWIFERY, COLLEGE OF HEALTH SCIENCE, ADDIS ABABA UNIVERSITY FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN PEDIATRIC AND CHILD HEALTH NURSING

OCTOBER, 2021

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF NURSING AND MIDWIFERY

PEDIATRICS AND CHILD HEALTH NURSING TRACK

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Full title	**Trend and determinants of treatment outcome of severe malaria among under-five children admitted in karat primary hospital, konso zone, southwest Ethiopia, 2021: Retrospective Cross-sectional study**
Study duration	**Sep 2016 - Aug 2021**
Study area	**Konso, Southwest Ethiopia.**
The total cost of the project	**37,682 ETB**
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APPROVAL BY THE BOARD OF EXAMINATION

This thesis by **Gudeta Kusheta** entitled "**Trend and Determinants of Treatment Outcome of Severe Malaria among Under-five Children Admitted in Karat Primary Hospital, Konso Zone, Southwest Ethiopia, 2021: Retrospective Cross-sectional Study**''is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of masters in pediatrics and child health nursing.

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STATEMENT OF DECLARATION

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ACKNOWLEDGMENT

Foremostly, I would like to thank almighty God who keep me a live today to undergo this thesis work despite swiftly changing turmoil of this ephemeral carnal universe. I would like also thanks Addis Ababa University, School of Nursing, and midwifery for providing opportunity to do this study. My special thanks also goes to Dire Dawa university for their sponsorship of my study.

Next, I would like to gratefully forward my genuine appreciation and special thanks to my advisors, Mr. Bereket Gebremichael (MSc, Assistant Professor, PhD Fellow) and Mrs. Hana Lijaemiro (BSc, MSc), for their unreserved encouragement, provision of relevant comments, and guidance of the overall process of this research development.

I would also like to thank konso zone health bureau, karat hospital administration, data collectors and supervisors for their contribution

Last but not least, my special thanks goes to Amanuel Dubale, Tamiru Tesfaye, Kumkumo Kussia and my classmates for their valuable support and constructive feedback throughout my study course.

ACRONYMS AND ABBREVIATION

AAU	Addis Ababa University
AOR	Adjusted Odds Ratio
CI	Confidence interval
EMIS	Ethiopian Malaria Indicator Survey
GTS	Global Technical Strategy
ITN	Insecticide Treated Net
IRS	Indoor Residual Spraying
PI	Principal Investigator
P.f	Plasmodium falciparum
P.v	Plasmodium vivax
RDT	Rapid Diagnostic Test
SM	Severe Malaria
SMA	Severe Malaria Anemia
SNNPRS	Southern Nations Nationalities Peoples Regional State
SSA	Sub Saharan Africa
SPSS	Statistical Package for the Social Science
WMR	World Malaria Report

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ABSTRACT

Background: Despite rigorous global and national efforts, malaria remains a significant cause of morbidity and mortality among under-five children. It causes a serious health and economic burden globally, in sub-Saharan countries including Ethiopia in particular. In 2019, children alone contribute 67% of the global malaria mortality burden. Few studies were conducted to determine the trend, treatment outcome of severe malaria and its determinants among under-five children in Ethiopia.

Objectives: The main aim of this study was to assess trend and determinants of treatment outcome of severe malaria among under-five children in karat primary hospital, konso zone, Southwest Ethiopia, 2021.

Methods: An institution based retrospective cross-sectional study was conducted. Consecutive sampling was applied for the trend analysis of five-year malaria incidence from Feb 08-Mar 08 2021. 254 charts were selected by systematic random sampling technique from June10-30,2021. Data was collected by trained data collectors using a pre-tested checklist. The collected data was cleaned and entered using Epi-data 4.6 and analyzed using SPSS version 25. Descriptive statistics was used to summarize the study variables. Bivariate and multivariable logistic regressions was used to determine the association between determinants and outcome variable. Odds ratio with 95% CI was used to show the direction and strength of association. P-value <0.05 was used to declare statistical significance.

Result: From a total of 7663 malaria suspects, 2572 was confirmed positive making over all positivity of 33.5%. *Plasmodium falciparum* attributed for 1904(74%) of confirmed cases. Fluctuating up and down trend with seasonal variation with highest cases was observed in autumn and the lowest in winter of the all years. Among 254 children admitted with severe malaria 37(14.6%) was died. Children in age group of 48-59 months AOR =0.04 (95% CI 0.00-0.87), government employed mothers AOR=0.19 (95% CI 0.04-0.92), co-morbidity AOR=14.08 (95% CI 3.04-65.27), prolonged hospital stay AOR=10.31(2.55-41.67) and late treatment seeking AOR=6.37 (95% CI,1.67- 25) were more likely to die.

Conclusion: Malaria remained the common public health challenge in the study area with no significant reduction during the five-year period. The mortality due to sever malaria was also high with various factors such as age of the child, maternal employment, co-morbidity, prolonged hospital stays and late treatment seeking was some of the factors that increased the odds of death. Therefore, intensification of key intervention activities should be implemented with the focus on the identified risk factors.

Key words: Severe malaria, Treatment outcome, Under-five children, Trend, Konso, Ethiopia

1. INTRODUCTION

1.1 Background

Malaria is a devastating global health problem over a century that has been plagued by humans throughout history by hampering the physical, social, and economic well-being of millions of people worldwide(1). It is a vector born; an acute febrile illness transmitted by the bite of infected female anopheles' mosquitoes. Among the parasite species that causes malaria in human beings are; *Plasmodium falciparum (P.f), P. vivax (P.V), P. malariae, P. ovale, and P. knowlesi,* zoonotic species known to infect humans. *P. f* causes most deaths whereas *P. v and P. malariae* causes milder form of malaria. The species *P.knowlesi* rarely cause disease in humans(2). Malaria is primarily a disease of the tropics and subtropics that widely spread in the humid regions of Africa, Asia, and South and Central America(3).

Malaria disease is classified as uncomplicated or complicated(severe). Malaria infection symptoms varies from absent or very mild such as fever, irritability, pain, refusal to eat and vomiting to severe fatal outcome(4). In children symptoms are also non-specific and resemble other common viral and bacterial diseases were blood test confirmation is highly recommended(5).

World Health Organization (WHO) defined severe malaria (SM) based up on either clinical or laboratory evidences of vital organ dysfunction that result mostly from *p. falciparum* infection. One or more of the following findings occurring in those affected by *P.f* (6). The findings include impaired consciousness or un-rousable coma or Blantyre coma score<3 in children, prostration (unable to sit unsupported (>1yr) or inability to drink or breastfeed (<1yr), respiratory distress (acidotic breathing/deep breathing or in-drawing of chest wall, multiple convulsions; more than two episodes within 24 hour, shock; systolic blood pressure < 50mm Hg, acute kidney injury, abnormal bleeding, clinical jaundice, acute pulmonary edema, hypoglycemia blood glucose sugar < 40mg/dl, metabolic acidosis (plasma bicarbonate < 15mmol/l), hyper parasitemia: *P.f* parasitemia >10%, and severe anemia (hemoglobin < 5g/dl)(6).

SM is multi-system and multifactorial disease mostly attributed by host and parasite determinants. The deadliest form cerebral malaria mostly cause retinopathy(7). Severe malarial anemia(SMA) is the most common other form which occurs in children with recurrent and inadequately treated infections(8). Another forms of SM are respiratory distress and acute kidney injury(9).

Even though significantly enhanced diagnosis and control intervention prevented 1.5 billion cases and 7.6 million deaths worldwide since 2000, malaria still causes high morbidity and mortality every year, particularly in Sub-Saharan Africa (SSA)(10). Nearly half of the world's population or 3.7 billion was estimated to be at risk of malaria in 2018 (11,12).

Despite setting massive scale-up control interventions in the national malaria strategic plan between 2017-2020, 2,634,971 malaria cases was expected in 2021(13). Case management, distribution of long-lasting insecticidal nets (ITN), and indoor residual spraying (IRS) are among main scale-up control intervention which targets reducing malaria cases by 40 % from baseline, maintaining near-zero malaria deaths by 2020 and, eliminating malaria from Ethiopia by 2030(14–16).

Despite, a dramatic reduction in disease burden malaria remains one of the leading public health and socio-economic problems in Ethiopia (17). In Ethiopia, 70 % of the population lives in the area below 2000m where 52 % of its people are considered at risk of infection (18). Malaria also contributes for 30 % of the overall disability adjusted life years that imposes a high economic cost (17). The reported 1,530,739 confirmed cases among under five children in 2016/2017 by the Federal Ministry of Health of Ethiopia is still a clear clue for a significant number of morbidity and mortality, making it the 8th cause of morbidity(19). In Ethiopia 12-16% of total malaria case was accounted by under-five children(13)

1.2 Statement of the Problem

Malaria is the biggest ever killer disease in history killed 50 billion people (20). It is endemic in 91 countries of the world(21). 2020 World Malaria Report (WMR) reported 229 million cases and 409,000 deaths in 2019 worldwide. SSA accounted for 94% of 215 million of the malaria cases in 2019 and 384,000 of the deaths (22,23). Children accounted for 67% of (274,000) of all malaria deaths in SSA countries, from 409,000 global deaths(23).

According to the 2019 WMR, under five children are the most vulnerable group affected by malaria. It is the third-highest infectious disease killing children worldwide.(12). Every two minutes, under-five children dies of malaria(22). In 2018, despite protecting 19 million children in twelve SSA countries through seasonal malaria chemotherapy programs, about 12 million children were not addressed, mainly due to a lack of funding (22).

SM contributes for 21.05% hospitalization(24) and mortality rate of 28.32% among under-five children(25). When multiple factors co-exist mortality exceeds 50%(26). As immunity is not yet developed in children; *P.f* multiplies exponentially by destroying red blood cells and progress to SMA which will end up with death in 24 hours if left untreated(27). Also one in four children will have neurological complication up to two years after admission of SM(28). It also contributes for more than one million annual anemia cases associated with repeated hospital admission and death after discharge(29). In addition to physical sequalae repeated infections significantly impairs cognitive development that resulting in malnutrition and stunting which impairs economic productivity in later life(30). Despite loss of income due to time off work it cost US$20 - US$136 for inpatient treatment(31).

In general, malaria is curable if diagnosed and treated early but it can progress to severe fatal outcome in failure to diagnose and manage early and properly(4). *P. f* accounts for 1% of SM. 52% of patients receiving injectable artesunate had sign of SM. Among factors that determine treatment outcome of SM parasite species(32), age of the host(33), residency(34), timing and efficacy of treatment, comorbidities, SMA(35), and

antimalarial drugs types(36).

Regardless of the 60% global mortality reduction from 2000 to 2019, the rate of change 57 in 2014 remains the same until 2018(37). Also significant gap was observed in quality of care for children with malaria(38). Recently progress remained the same in some African countries (38,39) providing clue that global malaria targets are being missed (22). The world to be in line with a 2020 global malaria incidence per 100,000 population at risk 45 cases was expected instead of being 57. If this current trend is maintained, estimated malaria cases would be 54 in 2020, 48 in 2025 and, 42 in 2030, instead of being 34, 14, and 6 respectively required to achieve the Global Technical Strategy(GTS) milestone(22). This implies 37% and 87% malaria case incidence reduction of WMR projection of GTS 2016-2030 will be missed by 40 % in 2020 and 90% in 2030. Also, malaria mortality rates will be off track by 22% in 2020 from the baseline of 2015(10,23). COVID-19 is also jeopardizing malaria elimination sssintreventions(40)(41).

Although Ethiopia has set a plan to eliminate malaria in some low-transmission settings by 2020, the disease remains a significant setback in most parts of the country. According to the 2020 WMR, Ethiopia reported 904,495 cases and 213 deaths in all age groups in 2019(23). Although, Seasonally unstable transmission, varying and weak reporting system among geographical location and age groups, informal treatment seeking, and different diagnostic techniques challenges in estimating extent of SM (5).

Despite the fact that under-five children shares most of malaria burden(42)(43), little is known about the trend and determinants of treatment outcome of SM among the most vulnerable groups, particularly under-five children. Also, no study is conducted in the study area; the study is aimed to provide recent up-to-date data focusing on under-five children to fill this gap.

1.3 Significance of the Study

To come up with evidence-based intervention; knowledge on the malaria trend, factors that influence the treatment outcome of SM is important in management of children with severe malaria in order to minimize morbidity and mortality. Targeted resource allocation and policy planning programs also need specific, reliable, and locally up-to-date data at the level of localities or health catchment areas. Therefore, this study is designed to provide recent baseline data on trend, treatment outcome of SM and determinants of the treatment outcome among under-five children to policymakers, managers in health system, researchers, health care providers, and non-governmental organizations (NGOs).

The study will provide policy makers and the managerial team to use the up-to-date findings for planning, allocating resources, and making decisions towards local, national, and global malaria control and elimination intervention targets. The finding of this study will also be used by researcher as a baseline for further investigation. The study also increases the knowledge of health care providers to identify factors that determine treatment outcome to provide lifesaving supportive care. Moreover, as malaria control and elimination interventions need team effort, the finding will inform community members and NGOs to enhance their contribution to work towards targets in an integrated manner.

2. LITERATURE REVIEW

2.1 Overview of Malaria Trends

Malaria's death left its mark on human history, bodies, drinks, and the economy across half of the world before being eradicated in many global regions. Africa is the world's region most affected by malaria in 2015, where nine out of ten malaria victims and every 12th child death that occurred in 2017 were malaria, which contributed to 12% of under-five children child mortality in the region(44).

In 2019, 229 million cases and 409,000 deaths were reported globally, which is lower than 238 million in 2000 but higher than 218 million in 2015 and 228 in 2018 (5). Nearly half of all malaria deaths burden in 2019 was accounted by six SSA countries. Nigeria, Congo, Tanzania, Burkina Faso, Mozambique and Niger attributed for 23%, 11%, 5%, 4%, 4% ,4% respectively (22).

The 2007, 2011 and, 2015 Ethiopia national malaria indicator survey (ENMIS) shows trend of malaria incidence among under-five children was 0.6, 0.7 and, 0.6 by microscope respectively(45). Overall malaria incidence is very low in areas below 2,000m. Incidence is high among under-five children of Gambella (6%) and Benshangul Gumuz (3%). Malaria admissions and deaths between 2001 and 2011 fell by 81% and 73% respectively(46).

Spatiotemporal Bayesian geo-statistical models estimate that due to COVID, major malaria control intervention will be reduced by 25% in Africa in 2020, which will double, and even to a greater increase in subsequent years. Due to movement restrictions, febrile children prefer to remain at home and seek care based on their families' decision(47). WMR of 2020 also warns disruption in 10%, 25%, and 50% access to effective anti-malarial treatment in SSA will lead to additional death of 19,000, 46,000, and 100,000 respectively (4).

2. 2 Sociodemographic Determinants

Transmission is unstable and varies from season to season and place to place which affects all races, age, and sex. Due to antimalaria and insecticidal resistance malaria that

has been under controlled is worsening(30). A hospital-based retrospective cross-sectional study in Jasikan district, Ghana from 2012-2016 on prevalence and trend of malaria with anemia among 30,082 under-five children showed raise fall fluctuating pattern which increased continuously from 2012 and peaked in 2014 and slightly decreased but again raised from 2015 to 2016. Prevalence was ranged from 58.7% to 62.7%. The highest number (62.7%) was observed in rainy season of both 2015 and 2016 among age group 24-35 months' age and lowest among 0-11 months of age(48).

Institution-based retrospective record review of under-five children admitted and managed in Konga Health Center, Hadiya zone, Southern Nation Nationalities Peoples Regional State (SNNPRS) from May 10 to June 16, 2015, also examined fluctuating gradual declining pattern from the period 2013–2015 observed except for the year 2012. Out of 5,210 retrieved and reviewed medical records, 2,459 patients (47.2%) were positive for malaria infection, from which 57% was due to *P. f and* 43% due to *P. v*. The five years (2011-2015) prevalence was 45%, 60%, 50%, 40%, and 40.4% respectively with an average 47.2%. An increasing trend was observed in autumn from September to November, and a decreasing trend in the number of new cases from December to May(49).

Cross-sectional study in Ghana on 2,449 children aged 6 to 59 months indicated that children of educated mothers have higher odds of protection than an educated mother. Also living in large family member increases odds of infection(50).

2.3 Distribution of Plasmodium Species

Effective treatment requires rapid identification of species to prevent the potentially fatal complication of SM (49,51). *P, f* is associated with major risk factors for perinatal, neonatal, and infant mortality. It also causes recurrent episodes up to 13 times a year among children. *P. v,* another main species, cause relapsing malaria prevalently and remain dormant in the liver only to reawaken even in the absence of a new mosquito bite(32). *P. f* is more dominant than *P. v*(52).

2.4 Treatment Outcome of Under-five Children with Severe Malaria

Cross-sectional study conducted among 845 children in four hospitals of Kisangani town, democratic republic of Congo on risk factor of mortality related to SM, from January to December, 2015 found that twenty nine out 845(3.4%) was died while 96.57% was recovered(53).

A Prospective observational study conducted on clinical spectrum and outcome of severe p.vivax among eighteen children admitted at a referral hospital of northern India from January 2012 to December 2012 reported two(11.1%) death(54).

Prospective study done at Mbale referral hospital in eastern Uganda, to assess the clinical spectrum, prevalence, and outcome of severe p. *f* malaria revealed overall hospital mortality among 662 children was 63 (9.5%) but was higher in children with severe anemia(19.5%) and cerebral malaria(33.3%) (35).

Institution based retrospective study on factors associated with a poor treatment outcome among Children treated for malaria in Ibadan, Southwest Nigeria indicated 1.4% death, 9.1% recovered with neurological complications, and 89.5% children recovered free of complications(33).

A four year retrospective study conducted among 102 children on predictors of fatal outcome of SM in children of Bhopal, Central India five were died and making overall mortality of 4.9%(55).

2.5 Determinants of Treatment Outcome of Severe Malaria among Under-Five Children

2.5.1 Sociodemographic determinants

A prospective study conducted between June 2009 - February 2010 on Clinical and laboratory predictors of outcome in cerebral malaria in suburban Nigeria reveled that age less than 3 years (p =0.03) was identified as predictor of mortality of children with cerebral malaria(56). Also study in Ibadan south Nigeria similarly reveled same finding were age below a year has poor outcome than older age (AOR = 5.99, 95% C.I = 1.15–31.15)(33). However retrospective study among children of Bhopal, central India on

predictors of fatal outcome of SM found female sex show statistical significance at p < 0.05(55). Study in Ghana by Clifford also found that children at age of 37 months has less odds of infection than others (95% CI, AOR =0.34).The study also revealed that females has lower mortality as the recovery is faster (50).

Community-based prospective cross-sectional fever surveillance undertaken on malaria infection, disease, and mortality among children and adults at six health-facilities on the coast of Kenya between March 2018 and February 2019 reported that malaria hospitalization and mortality was highest among children aged six months to 4 years. SM and death among >15 are rare(57).

A retrospective case-control study that conducted to assess predictor of mortality in hospitalized children with SM among 126 cases and 126 controls in Northern Zambia concluded that children who come from rural areas has odds of death by 4% (AOR 1.04, 95% CI, 1.01–1.07, P< 0.01) than urban children(34).

2.5.2 Clinical and laboratory determinants

An observational study of 27 year analysis of 18,000 children admitted to Kilifi hospital, Kenya, from 1989 to 2016 with malaria indicated that hypoglycemia 1.93 (1.17-3.2, P= 0.01), cerebral malaria 3.81 (2.54 to 5.74) P= 0.0001, acidosis 3.31 (2.09 to 5.25) P= 0.00, kidney injury 2.45 (95% CI, 1.29 - 4.63, P= 0.006), and respiratory distress 2.23 (1.45 to 3.42) P= 0.0002 was found as a predictors of mortality(58).

Study in Southwest Nigeria on factors associated with a poor treatment outcome among children treated for malaria found that loss of consciousness (AOR = 4.55, 95% CI = 1.72–12.08, and p=0.002), and hypothermia (AOR = 11.52, 95% CI =1.07–123.64, and *P* = 0.04) was found as a significant predictors of a poor treatment outcome (33).

A prospective descriptive study on clinical spectrum of severe childhood malaria in Eastern Uganda revealed that hypoxemia (AOR, 3.64 (95% CI 1.39–9.52; P = 0.008), severe anemia [AOR, 5.36; 2.16–1.32; P = 0.0002], hyperlactatemia (AOR 3.66; 1.72–7.80; P = 0.001), and hepatomegaly (OR 2.29; 1.29–4.06; P = 0.004) was found as predictors of treatment outcome of severe malaria(35).

Descriptive cross-sectional study conducted on outcome and clinical spectrum of children admitted with various malaria species revealed mixed infection was found higher than *P.f* and *P.v* p=0.04(59).

Observational study on survival outcome and clinical presentation of SM among 134 hospitalized children found that shock and respiratory distress was found to be poor predictor of survival of children with severe malaria(60).

Retrospective study in children of Bhopal, central India on predictors of fatal outcome of SM revealed that children with severe anemia has 2.92 (1.103-7.712) higher fatal outcome than those without anemia(55). Study in southwest of Nigeria Lagos state on acute kidney injury among 244 children with malaria Suggests that six out of ten children has acute kidney injury which is associated with poor prognosis and prolonged hospital stay than those without acute kidney injury(61).

2.5.3 Antimalarial drug types

Randomized control trials conducted on 150 Ugandian children on assessment of parasite clearance with intravenous artesunate in severe P.*f* found rapid and adequate relief with well tolerated adverse effects(62). Parenteral artesunate was found to be highly efficacious than quinine in case of SM managements were complication progress very rapidly that leads to death (36).

2.5.4 Other determinants

Analytical retrospective study among under-five children with severe acute malnutrition and SM in Lubumbashi, in the province of Haut-Katanga reveled high mortality rate (AOR = 3.32; 95% CI: 1.56-7.06) among under-five children with SM (25). Study on delayed treatment seeking progression rate of uncomplicated malaria to severe form also stated that children who seek treatment early since onset of symptoms has lower risk of progression to severe form of the disease [AOR = 1.33, 95% CI: 1.07–1.64] for a delay of >24 (63). Retrospective study on determinants of mortality, intensive care requirement and prolonged hospitalization in south west India revealed seven days of hospital stay and more is less likely associated with risk of mortality (AOR= 0.11, 95% CI (0.01 - 0.91) P= 0.04(64).

2.6 Conceptual Framework

The conceptualized framework from reviewing related literature (35-52) on treatment outcome of SM and its determinants which are grouped as socio-demographic, clinical, anti-malarial and other determinants are schematically summarized as follow

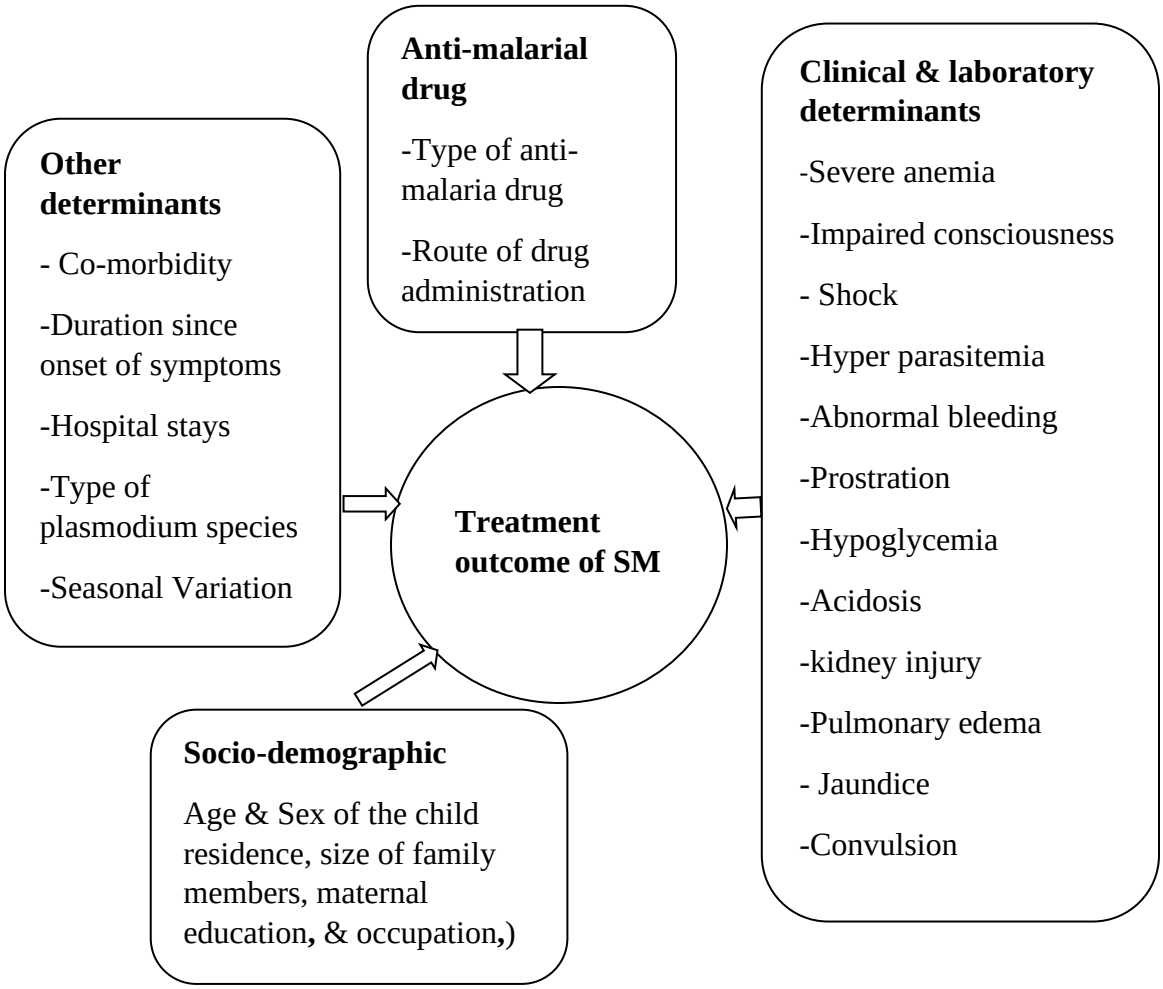


Figure 1:Conceptual framework for the study of determinants of treatment outcome of severe malaria among under-five children in karat primary hospital, konso, southwest Ethiopia, 2021

3. OBJECTIVES

3.1 General Objective

To assess trend and determinants of treatment outcome of severe malaria among under-five children admitted in karat primary hospital, Konso zone, South-west Ethiopia, September 2016- August 2020.

3.2 Specific Objectives

1. To assess five-year trends of malaria incidence among under-five children in karat primary hospital, konso zone, Southwest Ethiopia, Sep 2016-Aug 2020

2. To determine treatment outcome of severe malaria among under-five children admitted in karat primary hospital, Konso Zone, Southwest Ethiopia, Sep 2016-Aug 2020.

2. To identify factors that determine treatment outcome of severe malaria among under-five children admitted in karat primary hospital, Konso Zone, Southwest Ethiopia, Sep 2016-Aug 2020

4. METHODS AND MATERIALS

4.1 Study Area and Period

The study was conducted in Karat Primary hospital, Konso zone, southwest Ethiopia, which is 595 kilometers (km) away from Addis Ababa, the capital city of Ethiopia. The hospital is located in karat, zonal town at the southwestern part of the country. It is located roughly between 5° 15′ 0″ North latitudes and 37° 29′ 0″ East longitudes and elevation ranges from 500- 2100 meters above sea level (65). The climate in a considerable portion (70%) is *Kolla* or arid and 30% *Woinadega* (sub-humid) of the total area. An average annual temperature is 23.95ºc, with range of 15.5ºc - 32.4ºc(66). The hospital begins its service in 2014 providing curative and preventive service in Medical, Surgical, Obstetrics and Gynecology, Emergency, Pediatrics and Neonatal wards with a total admission capacity of 114 beds.

The study for trend analysis was conducted from February 08 - March 08, 2021. But study period for treatment outcome of determinants SM was from June 10-30, 2021.

4.2 Study Design

A hospital-based retrospective cross-sectional study was conducted.

4.3 Population

4.3.1 Source population

Source population for trend analysis: All under-five children suspected for malaria and registered in malaria morbidity logbook

Source population for treatment outcome of SM and its determinants: All under-five children who was admitted for SM.

4.3.2 Study population

Study population for trend analysis: All under-five children confirmed for malaria and registered in malaria morbidity logbook over the study period.

Study population for treatment outcome of SM and its determinants: All selected medical records of under-five children admitted with SM over the study period

4.4 Inclusion and Exclusion Criteria

4.4.1 Inclusion criteria

Inclusion criteria for trend analysis:

- Under-five children confirmed for malaria and recorded on malaria morbidity log book from September 2016-August 2020

Inclusion criteria for treatment outcome and determinants of severe malaria:

- Complete medical records of under-five children who admitted by fulfilling at least one of the WHO criteria for SM indicators from September 2016-August 2020

4.4.2 Exclusion criteria

Records of under five children with incomplete and illegible for variables of study.

4.5 Sample Size Determination and Sampling Technique

4.5.1 Sample size

All 2572 underfive children confirmed from 7663 suspects for malaria over the past five year was included for the trend analysis of malaria incidence and sample size for the assessment of determinants of treatment outcome of SM was calculated by using single population proportion formula by considering p =0.62 recovery outcome (25), 95% of CI, margin of error(5% d= 0.05), and the number of children admitted with SM over the past five year from Sep 2016- August 2020 was 692.

$$n = \frac{\left(Z\frac{\alpha}{2}\right)2 * p(1-p)}{d2}$$

Were

n= required sample size

Z= critical value at 95% CI which =1.96

P=prevalence rate

d= margin of error tolerated (5% d= 0.05),

$$n= \underline{(1.96)^2 0.62(1-0.62)} = 362$$

$(0.05)^2$

Hence, the total population(N) 692 is less than 10,000 adjusting for the final sample

$n_{final} = n/1+n/N$

=362/1+362/692=> 362/1.52=238

Adding 10% for incomplete and illegible the final sample was **262** medical records.

4.5.2 Sampling technique and procedure

All under-five year children confirmed for malaria and registered with complete data in malaria morbidity log book over the past five year was consecutively included for trend analysis. Sampling technique for assessment of treatment outcome and its determinants for SM was applied as follows: Medical records of under-five children admitted with SM over the past five year was proportional allocated for each year and systematic random sampling technique was applied to select study subjects to address the required sample size. Sampling interval(k) was calculated by dividing the total number of children admitted with SM by the sample size proportionally allocated for each year. The first sample is selected by lottery method and when the selected record in the sampling interval is excluded from the study; it was replaced by the next record and the interval was maintained accordingly. During the last five year (September 2016-August 2020) 692 under-five children with SM was admitted to karat Primary hospital. Out of this admission 128,115,152,161,136 was from September-August 2016 to 2020 respectively. Proportionally allocation of 262 study subjects for each year was done as follows;

$$ny = \frac{n \times NY}{N}$$

Where; ny= required sample size from each year (year 1- year 5 or 2016-2020)

n= total sample size

NY= total number of under-five children with severe malaria for each year (NY1-NY5)

N= total number of under-five children with severe malaria over the five years.

$ny1(2016) = ny = \frac{n \times NY}{N} = \frac{262 \times 128}{692}$= 48, k= 2

ny2(2017) = $ny = \frac{n \times NY}{N} = \frac{262 \times 115}{692}$ = 44, k=2

ny3(2018) = $ny = \frac{n \times NY}{N} = \frac{262 \times 152}{692}$= 58, k=2

ny4(2019) = $ny = \frac{n \times NY}{N} = \frac{262 \times 161}{692}$= 61, k=2

ny5(2020) = $ny = \frac{n \times NY}{N} = \frac{262 \times 136}{692}$= 51 k=2

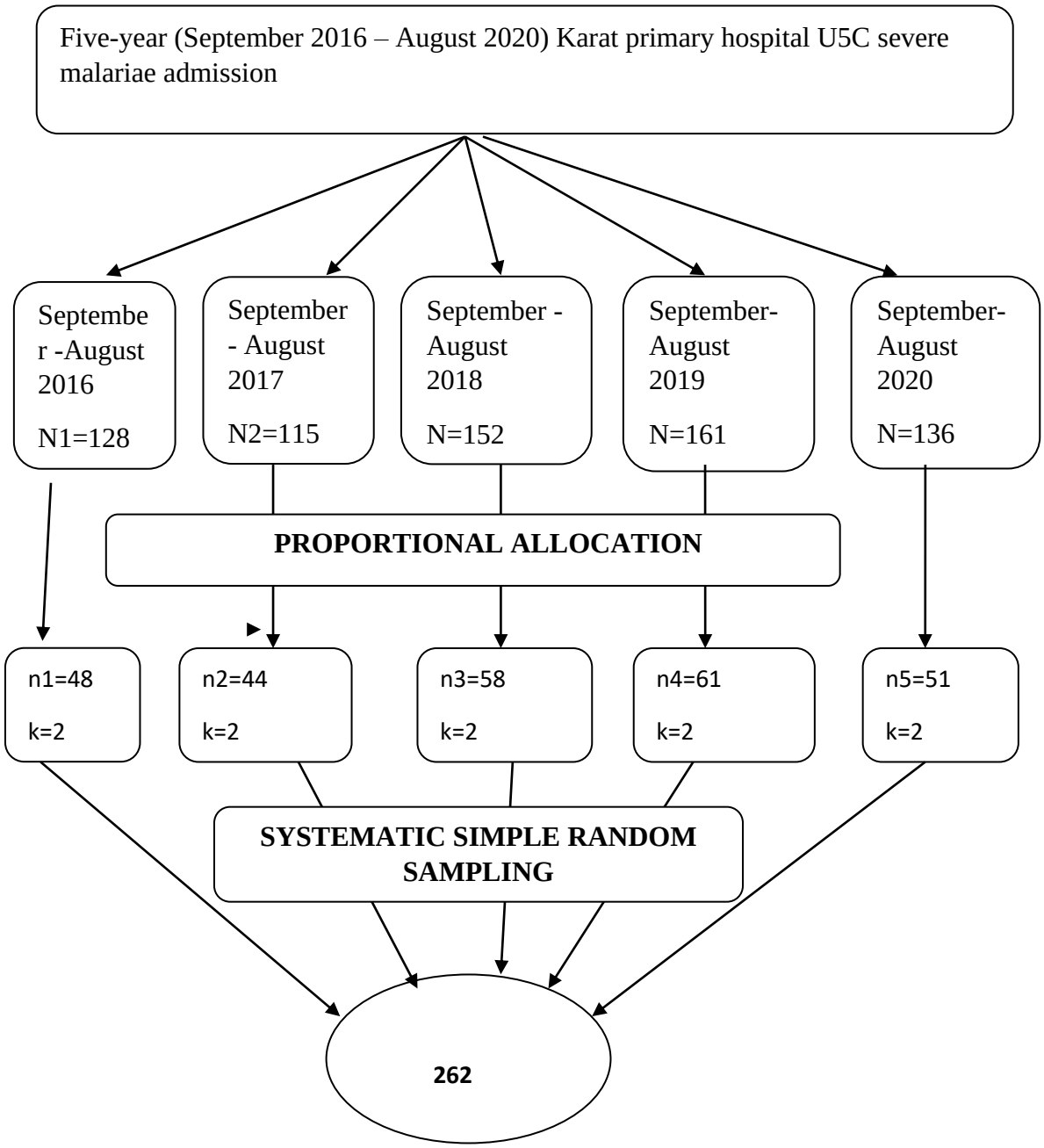


Figure 2:Diagrammatic representation of sampling procedure and technique for the study of trend, treatment outcome of severe malaria and its determinants among under-five children in karat primary hospital, konso, Southwest Ethiopia, 2021.

4.6. Study Variables

4.6.1 Dependent variable

Treatment outcome (Death/recovery)

4.6.2 Independent variables

Socio-demographic: (Sex & Age of the child, place of residence, house hold size, maternal occupation and educational status)

Clinical determinants: (Severe anemia, impaired consciousness, shock, hyper parasitemia, abnormal bleeding, prostration, hypoglycemia, acidosis, kidney injury, Pulmonary edema, jaundice, convulsion)

Anti-malarial drug: **(**Type and route of administration)

Plasmodium Species (*P. f, P.v* and mixed)

Other determinants: (Duration since onset of symptoms, hospital stay and seasonal variation)

4.7 Operational/Definition of Terms

Suspected malaria case: Children with fever, history of fever, and lives in malaria-endemic areas or has a history of travel within the last 30 days to malaria endemic areas

Confirmed malaria case: microscopic confirmation of malaria parasite among suspected children.

Trend: Patterns of malaria incidences from year to year (2016-2020)

Treatment outcome: Death or recovery among children admitted with SM

Death: Are those children confirmed died

Recovered: Are those children discharged home well

Comorbidities: A medical conditions presented in children with SM

4.8 Data collection instrument and procedures.

Five consecutive years; 2020 -2016 were purposively selected for record reviews because they provide latest information about problem under investigation.

Data for trend analysis was collected from malaria morbidity logbook by pretested checklist in karat health center adopted and modified from studies (48,49).

Data for determinants of treatment outcome of SM was collected from medical record of under-five children admitted with SM by pretested checklist adopted from studies (24,32-35,50-54). Pre-test on 5% (13 charts) of the calculated sample size was done before actual data collection. Two medical records from each year for 2016 and 2017 and three from 2018-2020 was selected randomly for the pre-test from the karat primary hospital which was latter excluded from actual data collection. During both data collection three clinical nurses were recruited under daily supervision by a BSc nurse supervisor.

4.9 Data Quality Control

Before data collection, data collectors and supervisors were trained for a day about the data collection tools, objective, and significance of the study. The supervisors closely supervised and monitored on daily basis for completeness and consistency of the collected data to ensure the quality of data. Finally, the collected data was checked, cleaned and compiled by the investigator on daily basis.

4.10 Data Processing and Analysis

Data was checked for completeness and consistency manually, and then coded and entered into the EpiData version 4.6 and analyzed using Statistical Package for the Social Science (SPSS) version 25. During analysis, data was cleaned carefully; missing values was handled not to be included in the analysis by double-checking through data exploration. Descriptive statistics such as frequency, proportion, and means with standard deviation was used to describe results. Model fitness was checked by Hosmer and lemeshow test($P>0.05$) and multicollinearity among independent variables was

checked by a variance inflation factor (0.37). Variables that showed significant association at P-value less than 0.25 in the bivariate analysis was entered for multivariable logistic regression analysis to identify predictors of treatment outcome of SM. Statistical significance was declared at p-value less than 0.05. The degree of association between dependent and independent variable was determined using AOR with 95% CI. Finally, the result of the study is presented using tables, graphs and texts.

4.11 Ethical Considerations.

Ethical clearance was obtained from Addis Ababa University (AAU), College of health sciences. An official letter from the university was submitted to zonal health bureau to obtain permission. Letter from zonal health bureau was obtained to communicate medical director of the hospital.

Access to records was obtained after explaining the purpose of the study. The obtained data was not disclosed to a third person despite study team and was kept confidentially. Data was coded and locked by password. Any name and/or other personal information with respect to study subject was not used. Upon getting the necessary data, an acknowledgment was forwarded to the respective body.

4.12 Dissemination and Utilization of Results

The findings of the study will be presented to AAU, college of health science, school of nursing, and midwifery, and both the hard and soft copy will be submitted to the university library and department. Another copy will be given to Konso zone health bureau and concerned governmental organizations at the study district and NGOs. Efforts will also be made to present study findings in different seminars and conferences. Publication in a reputable journal will also be considered.

5. RESULT

Two different study population were used for this study. Records of clinically suspected under-five children for malaria and under-five children admitted with SM from September 2016 - August 2020 was used for malaria incidence trend analysis and determinants of treatment outcome of SM respectively.

5.1 Five Year Retrospective Malaria Incidence Trend

5.1.1 Sociodemographic characteristics of study participants for trend analysis

During September 2016 - August 2020, 7947 under-five children was clinically suspected for malaria. From these 7663 records of under-five children was found complete and included for analysis. 284 records were excluded due to incompleteness and illegibility. Among 7663 complete records 2572 slides were microscopically confirmed for malaria making overall slide positivity rate of 33.5%. From malaria positive tests 1,492 (58%) were males and 1598 (62.1%) are in age group of 1-4 years. Higher proportion of malaria parasite was observed among rural children 2,291(89%).

Table 1: Sociodemographic characteristics of study participants for trend analysis of malaria in karat primary hospital, konso, Southwest Ethiopia,2021

Characteristics		Frequency	Percent (%)
Sex	Male	1,492	58%
	Female	1080	42%
Age	<1 year	974	37.9%
	1-4 year	1598	62.1%
Residency	Urban	281	11%
	Rural	2,291	89%
Total		2572	100%

5.1.2 Distribution of plasmodium species

Among confirmed malaria tests plasmodium falciparum species was found to be dominant in the study area 1904(74%).

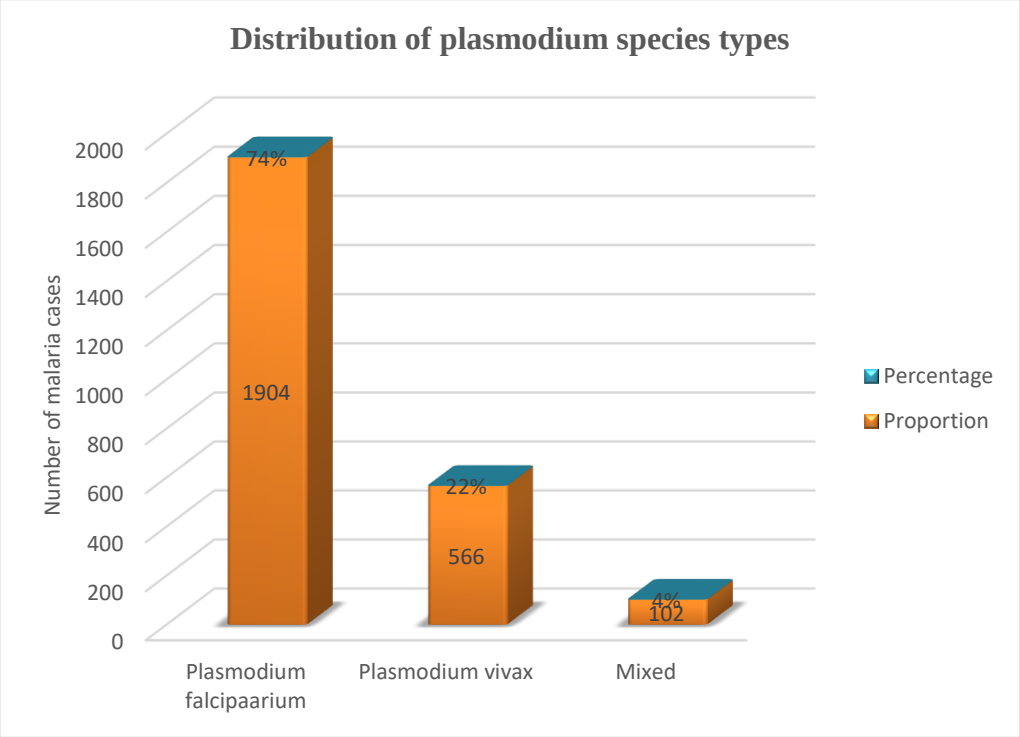


Figure 3: Distribution of plasmodium species among under-five children tested for malaria in karat primary hospital, konso, southwest Ethiopia, 2021.

5.1.3 Retrospective trend of malaria cases

The malaria incidence in the study area ranges from 31.3% to 38% where the highest prevalence (38.4%) of confirmed cases was recorded in the year 2018 and the lowest 31.3% were recorded in 2017.

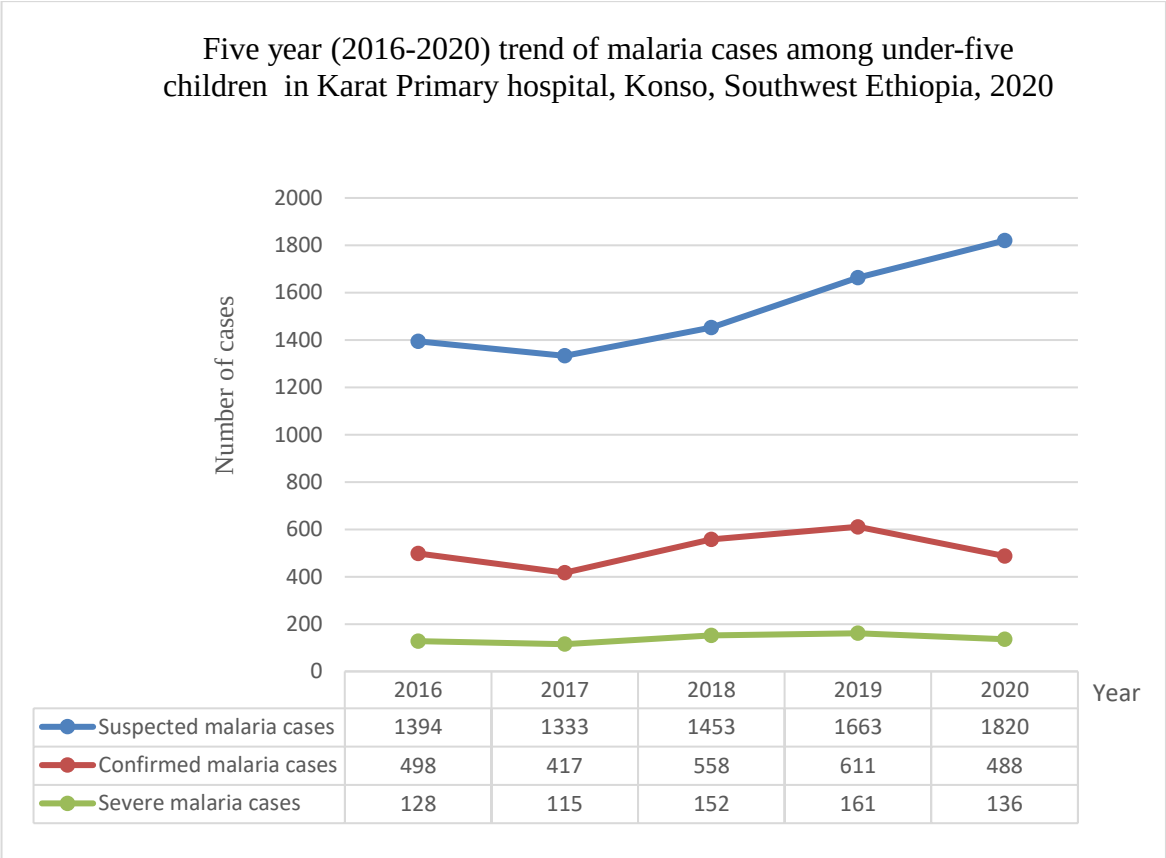
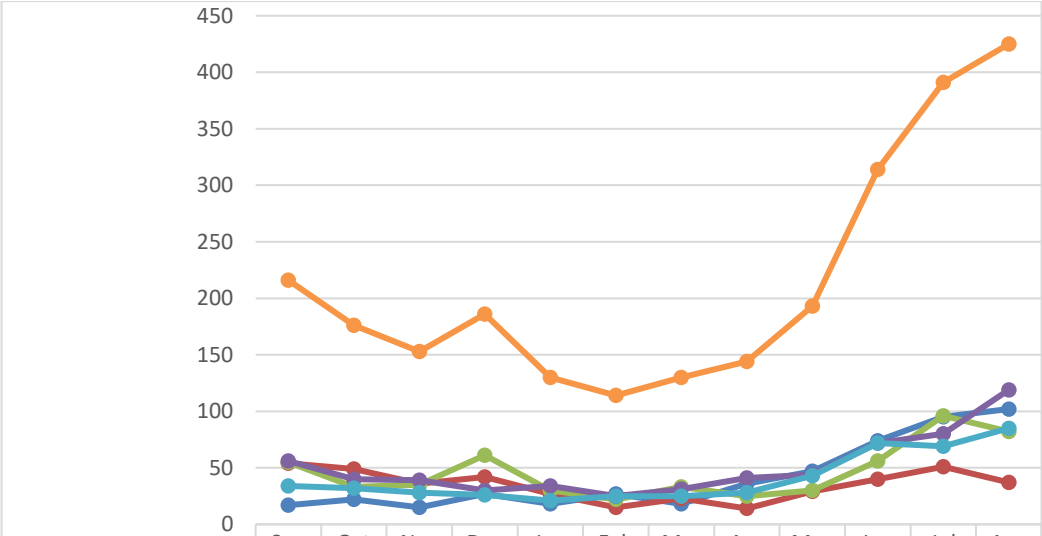


Figure 4: Five-year trend of malaria cases among under-five children in Karat Primary hospital, Konso, Southwest Ethiopia,2021

5.1.4 Seasonal variation of malaria cases

Malaria cases occurred all throughout the year over the four seasons with highest cases in autumn 1,130 (June- August) and lowest 430 during winter (December- February). The highest peak from all of the five year was recorded in autumn season of August month in 2019. Gradually increasing trend starts from summer (March - May) of all years which peak in autumn of almost all years. Spring (September -November) shows gradual declining trend until the beginning of summer.



	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
2016	17	22	15	27	18	27	18	36	47	74	95	102
2017	54	49	36	42	27	15	23	14	29	40	51	37
2018	55	33	35	61	30	22	33	25	30	56	96	82
2019	56	40	39	30	34	25	31	41	44	72	80	119
2020	34	32	28	26	21	25	25	28	43	72	69	85
Five year Trend	216	176	153	186	130	114	130	144	193	314	391	425

Figure 5: Five-year seasonal variation of confirmed malaria cases by months among under-five children in Karat Primary Hospital, Konso, Southwest Ethiopia,2020

5.2 Treatment Outcome of Severe Malaria and its Determinants

5.2.1 Sociodemographic characteristics of study participants for determinants of treatment outcome of severe malaria

From 262 records the study included records of 254(96.9%) children admitted with SM from September 2016 to August 2020. Out of a total 254 children almost two third or 157(61.8%) were males and majority or 208(81.9%) of children are rural residents. The age of the children ranges from 06 months up to 59 months with median age of 33 months and majority or 60(23.6%) of the children were in the age group of 24-36 months. Concerning maternal characteristics most of mothers or 113(44.5%) have primary education status and more than half or 139(54.7%) mothers are farmers.

Table 2:: Distribution of socio-demographic characteristics of children with severe malaria admitted in Karat Primary hospitals, Konso, Southwest Ethiopia, 2021.

Variables		Frequency	Percent
Age of the child in months	<11	32	12.6
	12-23	50	19.7
	24-35	60	23.6
	36-47	59	23.2
	48-59	53	20.9
Sex of the child	Female	97	38.2
	Male	157	61.8
Place of residency of the child	Urban	46	18.1
	Rural	208	81.9
Maternal educational status	No formal education	57	22.4
	Primary (Grade 1-8)	113	44.5
	Secondary (9-12) & above	84	33.1
Maternal Occupation	Farmers	139	54.7
	Gov't employed	115	45.3
Number of family members	<5	42	16.5
	>5	212	83.5

5.2.2 Clinical, laboratory and other determinants

Most of children 173(68.1%) with SM had history of onset of symptoms of less or equal to five days. From 254 admission with SM 106 (41.7%), 100 (39.4%), and 42(16.5%), have respiratory acidosis, prostration, and compensated shock as a clinical presentation respectively. Among 77 children with co morbidity 46 (60.3%) had pneumonia. Almost two third 170 (66.9%) of the children admitted hospital had hospital stay of less than or

equal to seven-day P.f was the most prevalent species among children with SM contributing for178 (70.1%) of the cases.

Table 3: Clinical and laboratory determinants and other determinants of children with severe malaria in Karat Primary Hospitals, Konso, Southwest Ethiopia, 2021.

Variables	Categories	Frequency	Percent
Duration since onset of symptom	</=5 days	173	68.1
	>5 days	81	31.9
SMA	No	188	74.0
	Yes	66	26.0
Impaired Consciousness	No	166	65.4
	Yes	88	34.6
Compensated shock	No	212	83.5
	Yes	42	16.5
Abnormal bleeding	No	243	95.7
	Yes	11	4.3
Prostration	No	154	60.6
	Yes	100	39.4
Hypoglycemia	No	187	73.6
	Yes	67	26.4
Respiratory acidosis	No	148	58.3
	Yes	106	41.7
Kidney injury	No	242	95.3
	Yes	12	4.7
Jaundice	No	233	91.7
	Yes	21	8.3
Pulmonary edema	No	240	94.5

	Yes	14	5.5
Convulsion	No	207	81.5
	Yes	47	18.5
Hyper parasitemia	No	216	85.0
	Yes	38	15.0
Co-morbidity	No	177	69.7
	Yes	77	30.3
Length of hospital stay in days	</= 7 days	170	66.9
	>7days	84	33.1
Type of malaria species	P. f	178	70.1
	P. v	68	26.8
	Mixed	8	3.1

5.2.4 Anti-malarial drug type and treatment outcome

Among 254 children for whom anti-malarial treatment was provided, 145(57.1%) were provided quinine as a treatment and the remaining 109(42.9%) were given artesunate. Most of the anti-malarial drugs 167(65.7%) were given through intravenous route and the remaining 87(34.3%) by Intra-muscular injection. From a total of 254 admitted children 217(85.4%) were recovered and 37(14.6%)

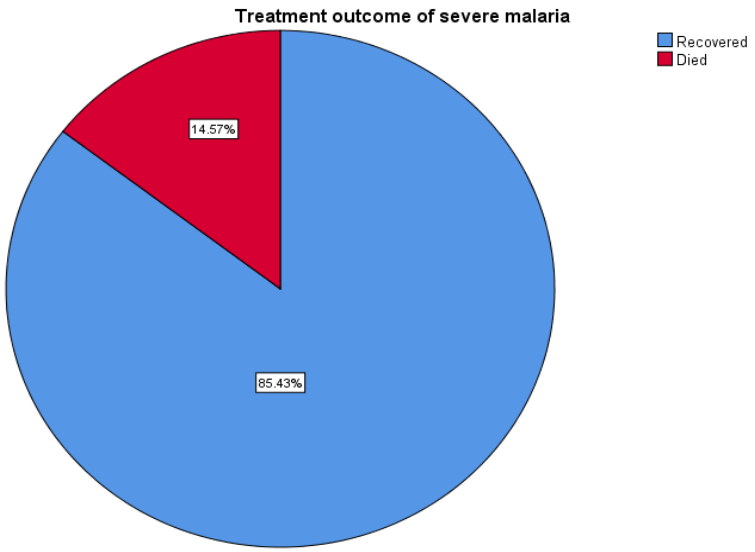


Figure 6:Treatment outcome of severe malaria among children admitted in karat primary hospital, konso, Southwest, Ethiopia 2021

5.3Determinants of Treatment Outcome of Severe Malaria.

Different socio-demographic, clinical, laboratory and other variables were tested for their association with the treatment outcome of SM among under-five children admitted with SM. First, all variables that have association with the outcome variables in bivariate logistic regression analyses at P< 0.25 were included in the multivariate logistic regression model. On bivariate analysis age of the child, maternal occupation, duration since onset of symptoms, compensated shock, hypoglycemia, hyper parasitemia, length of hospital stays, co-morbidity, treatment provided and types of malaria species were significantly associated with treatment outcome of SM.

After adjusting for potential confounder age of the child, maternal occupation, duration since onset of symptoms, length of hospital stays, and co-morbidity were found significantly associated with treatment outcome of severe malaria at p <0.05).

Multivariate analysis indicated age of the child in months was found as a determinant of treatment outcome among under-five children admitted with SM. Children in age group 48-59 months has 96% less likely odds of death from SM; AOR =0.04(95% CI 0.00-0.87) than children in age group of 6-47 months.

Maternal occupation was also found as another significant predictor that determine treatment outcome of SM. Children whose mothers are government employed has 81% less likely to have death after SM admission compared to mothers who are farmers (AOR=0.19(95% CI 0.04-0.92).

The other significant determinant of treatment outcome from clinical determinant was treatment initiation duration since onset of symptom. Children who sought treatment lately after the onset of symptoms greater than five days have 6.37 more likely to die than those who seek treatment earlier AOR=6.37(95% CI, 1.62- 20.0).

The likelihood of dying from SM was 14.08 higher than among children with co-morbid illness than their counterpart AOR=14.08(95% CI, 3.04-65.27). Another independent predictor of mortality for SM was prolonged hospital. Children who were stayed in hospital for more than seven days has 10.31 odds of death than children discharged within a week; AOR10.31(95% CI, 2.55-41.67)

Table 4: Bivariate and multivariate analysis of determinant of treatment outcome among children admitted with severe malaria in karat primary hospital, Konso, Southwest, Ethiopia 2021

Variables	Categories	Treatment outcome		COR (95%CI)	AOR (95%CI)	P-value
		Recovery	Death			
Age of the child in months	<11	15	17	1	1	
	12-23	42	8	1.68(.60-4.69) *	.61(.08-4.47)	.63
	24-35	54	6	.0981(.33-.29) *	.23(.04-1.54)	.13
	36-47	54	5	.08(.03-.26) *	.29(.03-2.41)	.25
	48-59	52	1	.02(.00-.14) *	**.04(.00-.87)**	**.04**
Sex of the child	Female	88	9	1		
	Male	129	28	.47(.21-1.05)		
Place of residency of the child	Urban	45	1	1		
	Rural	172	36	.11(.01-.79)		
Maternal educational status	No formal education	33	24	1		
	Primary	102	11	29.82(6.67-133.37)		
	Secondary & above	82	2	4.42(.95-20.51)		
Maternal Occupation	Farmers	106	33	1	1	
	Govt, employee	111	4	.12(.04-.34) *	**.19(.04-.92)**	**.04**

Number of family members	</=5	35	7	1		
	>5	182	30	.82(.34-2.03)		
Time since onset of symptom	</=5 days	164	9	1	1	
	>5 days	53	28	9.63(4.27-21.69) *	**6.37(1.62-25.0)**	**.008**
SMA	No	169	19	1		
	Yes	48	18	3.34(1.62-6.85)		
Impaired Consciousness	No	139	27	1		
	Yes	78	10	.66(.30-1.44)		
Compensated shock	No	191	21	1	1	
	Yes	26	16	5.59 (2.6-12.07)	2.96(.62-14.16)	.17
Abnormal bleeding	No	206	37	1		
	Yes	11	0	.00 (.00-		
Prostration	No	132	22	1		
	Yes	85	15	1.06 (.52-2.16)		
Hypoglycemia	No	169	18	1	1	
	Yes	48	19	3.71 (1.81-7.64) *	2.4(.54-10.7)	.25
Respiratory Acidosis	No	129	19	1		
	Yes	88	18	1.39 (.69-2.8)		
kidney injury	No	205	37	1		
	Yes	12	0	.00 (.00		.
Jaundice	No	196	37	1		
	Yes	21	0	.00 (.00		
	No	204	36	1		

Pulmonary edema	Yes	13	1	.44(.06-3.44)		
Convulsion	No	173	34	1		
	Yes	44	3	.35(.10-1.18)		
Hyper-parasitemia	No	180	36	1	1	
	Yes	37	1	7.4(.98-55.68) *	.15(0.01-2.67)	.20
Treatment provided	Artesunate	87	22	1	1	
	Quinine	130	15	.46(.22-.93) *	.55(.15-2.08)	.38
Route of drug administration	IV	133	34	1		
	IM	84	3	.14(.01-.11)		
Co-morbidity	No	174	3	1		
	Yes	43	34	45.86(13.45-156.39) *	**14.08(3.04-65.27)**	**0.001**
Length of hospital stay in days	</= 7 days	165	5	1		
	>7days	52	32	20.3(7.53- 54.8) *	**10.31(2.55-41.67)**	**0.001**
Type of malaria species	P. f	144	34	1	1	
	P. v	67	1	.61(.01-.46) *	.10(.011.03	.053
	Mixed	6	2	.58(.07-4.9)	.37(.05-2.87	.341

***Note**; *= significant at p< 0.25 in bivariate analysis*

***Abbreviations**: COR, Crude odds ratio; AOR, Adjusted odds ratio;*

6. DISCUSSION

Malaria still remains a public health agenda in endemic geographical settings(67). The primary intention of this study was to gain in-depth understanding of trend and determinants of treatment outcome of SM to avert the overwhelming morbidity and mortality among under-five children. The study investigated fluctuating up and down trend of malaria with the overall slide positivity of 33.5% where *P.f* was attributed for 74% of malaria cases. Among children admitted with SM 14.6% has treatment outcome of death. Age of the child, maternal occupation, late initiation of treatment and compensated shock was found as a determinant of death among children with SM.

The finding of this study revealed that the overall slide positivity was 33.5%. This result was higher than national malaria elimination plan were 1.2% is expected to be positive from suspects(17). It is also higher than studies done in Gambella (6%) and Benshangul Gumuz (3%) regions stated in national figure of EMIS(46). However the finding was also lower than studies conducted in Hadiya zone(47.2%)(49) and Jasikan district of Ghana(48). These difference may be attributed due to variation in climate, altitude, availability of perennial rivers that facilitate breeding of the parasite, and differences in malaria control interventions and intensity of malaria transmission among study setting and population(17).

P. f and *P.v* was found to be the most dominant species in the study area with the lethal *P. f predominance* attributing for 74% of the overall malaria cases followed by *P. vivax*. This finding is almost similar to study conducted in Pawe hospital, Benishangul Gumuz Regional state; 76% predominance of *P. f* (68). Ethiopian national profile of malaria parasite distribution also provides similar result indicating *P.f* and *P.v* are the two dominant malaria parasites(4).

Fluctuating up and down heterogeneous trend of the cases were observed through the study years. Inconsistent pattern of distribution from month to month and year to year was observed. The highest cases were recorded during autumn (Jun- August) and lowest cases of malaria were observed during winter: the minor transmission session (December - February). Lower confirmed case was recorded in the year 2017 than 2016 which again

slightly peak since 2017 to 2019 and declined in 2020. This up and down fluctuating trend pattern was also in line with study done in Boricha district of SNNPRS Ethiopia(69) . This variation is probably due to seasonal climatic change, presence of irrigation sites, and existence of perennial rivers in the area(66).

Regarding treatment outcome of SM 14.6% under-five children over the past five year was died. This result is higher than 2020/21 national woreda based health sector annual plan of reducing malaria mortality from 0.3 per 100,000 population at risk to zero (70). Also the current finding is higher than study conducted in Ibadan Nigeria 1.4%(33), Central India 4.9%(55), Kisangani town of democratic republic of Congo 3.4%(53), and Northern India 11.1%(54). However the current finding is lower than the finding of Uganda which is higher in children with cerebral malaria(33.3%) and severe anemia (19.5%)(35).This difference may be due to varying sample size, socio-economic, health seeking behavior and quality of comprehensive malaria control and management packages from country to country(38).

From the sociodemographic determinant as a treatment outcome of SM; age of the child in months and maternal occupation was found as a determinants of treatment outcome among under-five children admitted with SM. The analysis indicated that children in age group of 48-59 months have less probability of death than children in age group of 6-47monthis. This finding is in line with study conducted in Kenya among children and adults were mortality was found to be high among children in age group of six months to four year(57). Also study in Ibadan south Nigeria similarly reveals same finding were age below a year has poor outcome than older age(33). Plausible reason may due to the immunity were young children are not immune to resist for malaria infection than older children(27).

Children whose mothers are government employed has less likely to have death after SM admission compared to others. This is indirect related to maternal educational which implies educated mothers take protective measures and identify symptoms of malaria early which allow them to seek treatment(33).

From clinical predictors duration since onset of symptoms was found to be a significant predictor of treatment outcome of SM. In this study late initiation of treatment after five

days of onset of symptoms were associated with higher odds of death than those who sought treatment earlier. This finding is similar to multicentered systemic review and meta-analysis study on the impact of progression of uncomplicated *P. f* malaria to SM(63). Similarly study in northern Zambia revealed same finding(34). This is due to the fact that when there is delayed initiation of treatment the stages of pathogenesis progress to advanced stage were routine therapy can not immediately produce effective cure(63).

Regarding co-morbidity children who has co-morbidity has increased odds of death than those without co-morbidity. The current finding is consistent with study conducted in southwest of Nigeria Lagos state were acute kidney injury among children with malaria is associated with poor prognosis and prolonged hospital stay than those without acute kidney injury(61).This is may be due to synergistic effect for mortality which affects multiple organ resulting in prolonged hospitalization and make diagnosis challenging(61).

6. 1 Strength of the study.

- The study incorporated five years consecutive data than a single point of time unlike other cross-sectional studies.
- The study was conducted among the mostly vulnerable groups of the society where particular information gaps has been observed which will serve as baseline for further researchers to advance on the topic of study.
- Both trend and determinants were assessed

6.2 Limitation of the study

- Due to retrospective nature of the study detailed picture of some independent predictors such as ITN, IRS, environmental factors, economic status, health facility system related factors, informational sources and paternal educational status were not assessed.
- Incomplete records were excluded and this may introduce bias
- Generalization of the finding is limited by its single facility nature and unknown population at risk in catchment area and nearby neighboring community

7. CONCLUSION AND RECOOMENDATION

7.1 Conclusion

The present study assessed five-year trend of malaria incidences and determinants of treatment outcome of SM among under-five children. From the five-year trend of malaria cases the study revealed that there is no apparent change of malaria with high prevalence throughout the study periods. Regarding treatment outcome of severe malaria and its determinants; age of the child, maternal occupation, late treatment seeking, co-morbidity and prolonged hospital stay was found as a significant determinates of treatment outcome of SM. Therefore, to achieve feasible control and elimination targets; planned comprehensive interventional packages and outcome and impact indicators of malaria should be intensified focusing on the identified determinants**.**

7.2 Recommendation

In order to avert the multifaceted problem of malaria among under-five children; holistic integrated preventive, curative and rehabilitative efforts are required.

For Researchers

- Due to methodological constraint further, prospective and multi-centered study should be done to yield more relevant information in high-risk population and areas which may provide information on determinants like malaria control intervention measures such as ITN usage and availability, IRS, environmental factors, economic status, informational sources and paternal educational status which was not assessed in this study.

For health care providers

- Health care providers should give due attention for children presenting with clinical presentation co-morbidity to manage proactively and closely as much as possible to avoid and minimize adverse outcome.
- Under-five children below age of 48 months presenting with SM should be managed cautiously with close monitoring.

- Health care providers should work collaboratively in an effective and efficient manner to minimize prolonged hospitalization and potential complications.

For policy makers

- Malaria control programs within the community should be closely supervised in supportive way to identify gaps of intervention to develop early action plan.

For the community

- Community members should be educated on the importance of early treatment seeking behavior for treatment after the onset of febrile symptoms among their children.
- Women empowerment should be prioritized to enhance maternal employment which improves quality of care of children including malaria.

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9. ANNEXIES

Annex-I: Information Sheet

Title of the Research proposal: Trend and determinants of treatment outcome of severe malaria among under-five children in karat primary hospital, konso zone, southwest Ethiopia 2021.

Name of Principal Investigator: Gudeta kusheta (BSc N.)

Name of the Organization: Addis Ababa University, College of Health science, school of Nursing, and midwifery.

Name of the Sponsor: Addis Ababa University

Introduction: This information sheet is prepared for the medical director of the hospital to make the concerned departments clear about the purpose of research, data collection procedures, and get permission to conduct the study.

Purpose of the Research thesis: To assess trend and determinants of treatment outcome of severe malaria among under-five children in karat primary hospital konso zone, southwest Ethiopia 2021.The study is also used to write a thesis as a partial requirement for the fulfillment of a Master's Program in Child Health and Pediatrics nursing for the principal investigator.

Procedure: To come up with the study objective, selected data of under-five children enrolled from September 2016 - August 2020, will be reviewed to obtain the required information from the records using a pre-prepared data abstraction checklist.

Risk and /or Discomfort: Since the study will be conducted by taking appropriate information from medical records, it will not inflict any harm on the study subjects. The name or any other identifying information will not be recorded.

Benefits: The study has no direct benefit for those whose document/ record is included. However, the study has indirect benefit for the participant and other clients in the program. This is because if program planners are preparing a predicted plan, there is a benefit for clients in getting appropriate care and treatment services for children with

severe malaria. The research work has a paramount direct benefit for health care planners, managers, NGOs, and other key stakeholders involved in malaria elimination at local, national, and global levels.

Confidentiality: To ensure confidentiality, the data on the chart will be collected without the clients' names and medical record numbers. The information collected for this research project will be kept confidential and stored in a file and used only for the study. Also, it will not be revealed to anyone except the investigator.

Person to contact: This research project was reviewed and approved by the institutional review board of college of health sciences, school of nursing and midwifery, AAU. If you want to know more information about the research and its undertakings, you can contact my advisors through the address below.

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Permission: Lastly, I kindly request to permit and forward your permission to the concerned body for cooperation so that the data collectors can get from responsible bodies in place.

Annex II: Data abstraction form for five-year malaria cases trend

S. NO	Date	Age in months	Sex		Residency		Plasmodium species confirmed			
			M	F	Rural	Urban	P. f	p. v	Mixed	Other (specify)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										

Annex III: A tool to assess treatment outcome of sever malaria and its determinants among under-five children in karat primary hospital, konso, southwest Ethiopia, 2021.

1. Sociodemographic Characteristics				
Item No	Questions	Answer	Code	Skip
101	Age	_____month		
102	Sex	1Male 2. Female		
103	Residency	1.Rural 2. Urban		
104	Educational Status of mothers	1. No formal education 2. Primary (Grade1-8) 3. Secondary (Grade 9-12) and above		
105	Maternal occupation	1. Farmers 2. Gov, t employed		
106	Family size in the household	1. < /=5 2. >5		
2. Clinical Determinants				
201	Duration since onset of symptoms	_____ days		
From the following clinical presentation and laboratory finding choose documented presentation correctly. More than one answer is possible				
202		**Severe malarial anemia:** A hemoglobin concentration <5g/dl or hematocrit<15%	1	

		Impaired consciousness: An un-rousable coma or Blantyre coma score<3 in children less than 2 yr., or a Glasgow coma score <11 for older children	2	
		Compensated Shock: capillary refill >=3s	3	
		Abnormal bleeding: Recurrent or prolonged bleeding from nose, gum, venipuncture site, hemateins or melaena	4	
		Prostration: unable to sit unsupported (>1yr) or inability to drink or breastfeed (<1yr)	5	
		Hypoglycemia: Blood glucose sugar< 40mg/dl,	6	
		Acidosis: Respiratory distress acidotic breathing/deep breathing or in-drawing of chest wall	7	
		kidney injury: plasma serum creatinine>3mg/dl	8	
		Jaundice: yellowing of the skin, mucosal surfaces, and whites of eyes caused by excess bilirubin	9	
		Pulmonary-edema; Radiologically confirmed or oxygen saturation <92% on room air with a fast breathing with chest indrawing	10	
		Convulsion: more than two episodes within 24 hours	11	
		Hyper parasitemia: P. falciparum parasitemia>10%	12	

3. **Anti-malarial Drug**				
301	Treatment provided	1.Artesunate 2. Quinine		
302	Route of administration	1. IV 2. IM		
4. Other Determinants				
401	Is there any co-morbidity	1. Yes 2`. No		
402	Length of hospital stay in days	_____days		
403	Type of malarial species	1. P. falciparum 2. P.v 3. Mixed		
	5 Treatment Outcome			
501	Treatment outcome	1. Died 1. Recovered		