



The Impact of Malaria on Primary Education in Rwanda, a Systematic Review and Meta-analysis: A Case Study of Primary Schools in Kicukiro District

Joie Lea Murorunkwere & Dr. Sylvestre Mbanza

University of Tourism, Technology and Business Studies, Rwanda

Corresponding Author Email: isimbilea@gmail.com

Abstract: Malaria parasite in primary school is gradually recognized as a pertinent public health problem, but the data on the actual occurrence and health consequences are insufficient. Research indicates that children who suffer from ill-health are less likely to attend or complete schooling. Malaria is a significant cause of morbidity and mortality in school-age children. The present study aimed at estimating the impact of malaria on school-based attendance, health and education outcomes. A systematic review and meta-analysis were conducted to assess malaria's impact on school performance among children aged from 6 to 14 years. A cluster randomized controlled trial was conducted in 57 primary schools in Kicukiro District. The first approach was school attendance checks, the second included prevalence of malaria infection, educational performance, and health-seeking behavior. From 3308 children randomly selected for assessment of school attendance, were composed of 1103 Children by Control and 2205 Children by Intervention. It is clear that from the intervention schools, girls had nearly twice the odds of attending at least one school than boys. The school characteristics of selected children from 18 schools in control and 39 schools in intervention groups respectively show that 66.7% were recorded as malaria case-control while 53.8% were malaria intervention. On the other hand, water and sanitation 38.9% recorded as control while 41% were reported as interventions. The study concluded that malaria provokes student absenteeism that implicates in pupils' poor performance. Although seemingly asymptomatic in the vast majority of cases, infection is associated with a number of non-specific symptoms in the children's histories. This argues for improved malaria surveillance and control among school children.

Keywords: Malaria, Prevalence, Education, Plasmodium infection. Rwanda

How to cite this work (APA):

Murorunkwere, J. L. & Mbanza, S. (2022). The impact of malaria on primary education in Rwanda, a systematic review and meta-analysis: A case study of primary schools in Kicukiro District. *Journal of Research Innovation and Implications in Education* 6(1), 149 – 156.

1. Introduction

Malaria infection remains a world public illness and this disease is transmitted to humans through bites of female anophelae mosquitoes. Once infected this can result in brain damage, coma, and death. The seriousness of symptoms depends, to a great extent, on the degree of parasitemia, itself a function of the number of infected bites suffered by the patient (Halliday et al., 2020). Globally, in 2019 the estimations were 229 million malaria cases accumulated from 87 malaria-endemic countries (WHO, 2020). This tropical disease has played

a negative effect particularly on schooling achievement in many countries (Percoco, 2018). In Africa, malaria is mainly prevalent where it is condemned to be 90% of child mortality (Cook et al., 2018). Apart from death, malaria also disturbs pupils to regularly attend classes that in return provoke pupil's absenteeism and poor school performance (Komakech & Osuu, 2014).

For instance, a study conducted in Nigeria in 2016 by Gboeloh and Elele concluded that 90.8 percent of the pupils are absent during illness and treatment as they are kept away from the school. This absenteeism cannot

allow the pupils to catch up on lost lessons, hence affecting the class performance (Gboeloh and Elele, 2016)

This study was guided by the following research questions:

- a) What is the impact of malaria on school attendance in Kicukiro primary schools?
- b) What are the effects of malaria on students' performance in Kicukiro primary schools?
- c) What is the healthcare-seeking behavior in Kicukiro primary schools?

2. Literature Review

2.1 Impact of malaria on school attendance

Malaria remains a key threat to health particularly in the poor countries where this disease is linked not only to the socio-economic burden but also to the considerable morbidity as well as mortality of people (WHO, 2016). In many countries, the effort of Malaria attention has been mostly focused on children under 5 years of age (WHO, 2017). However, in sub-Saharan Africa, a big number of affected malaria is found in school-aged children compared to children under-five (Makenga et al., 2020). In East Africa, the prevalence of malaria among the school age vibrates between 1 to 64% while in West Africa the prevalence ranges from 1 to 83% (Siffit et al., 2016).

Under those circumstances, malaria has a significant impact on school attendance. In Africa, Halliday et al. (2020) pointed out that malaria contributes between 5 percent to 8% of school absenteeism and this count 50% of absenteeism that may be prevented.

In Rwanda, more than 83% have knowledge about malaria due to the spread of information through radios, televisions, community health workers' mobilization, community meetings, and others (Karema et al. 2020). Nevertheless, after some years of malaria decline in Rwanda, the disease increases in some locations of the country where the occurrence surpasses the thresholds of 5% and 10% throughout the country (Nzabakiriraho, and Gayawan, 2021). Generally, the presence of malaria in school-age children has shown different symptoms and that embrace school absenteeism, reduction of pupils' cognitive development which results in low school performance (Nankabirwa et al., 2013).

2.2 Effects of students' malaria on school performance

Malaria infection continues to be a world threat problem. Globally, in 2019 the estimations were 229 million malaria cases accumulated from 87 malaria-endemic countries (WHO, 2020). Malaria is a parasitic infectious disease that is spread by the Anopheles mosquito, particularly plasmodium species. When the infection is not treated on time, species Plasmodium falciparum and Plasmodium oval infections last 2 to 3 weeks. A patient with malaria suffers from anemia. In addition, infected children may display tiredness, malaise, abdominal pain, nausea, vomiting, and diarrhea. In the cases of severity, a patient exhibits somnolence, seizures, and coma (Halliday et al., 2020).

Equally important, many tasks of malaria in childhood can affect the process of acquiring knowledge and skills and understanding through thoughts and senses lead to impairment of children's memory. Hence, malaria affects children's school performance (Vorasan et al., 2015). Research conducted by Orish et al. (2018) on asymptomatic Plasmodium falciparum infection and poor school performance in primary school children in the Volta Region of Ghana results that there is significance noted with plasmodium falciparum infection as well as anemia and low children school performance in the arithmetic at school.

2.3 Health seeking behaviors in primary schools

According to WHO (2017) health is explained as good when a person is physically, mentally, and socially well-being fit and there is the absence of any disease or infirmity. Child illnesses are considered the main global health problem. These problems are predominantly in Asian and African subcontinents (Weldesamue et al., 2019). In Rwanda, malaria is also a disease that is a public health concern because the whole population is at risk of contracting this infectious disease. It has been the central cause of different health problems like morbidity and mortality for several years (NISR, 2015). The measures taken by the government of Rwanda include the mandatory establishment of a health insurance scheme known as mutuelle de santé. This has vigorously helped the citizens of Rwanda to access private or public health centers, clinics and hospital services (Habyarimana, & Ramroop, 2020). Again, there was a distribution of insecticide-treated mosquito nets (ITNs) to the whole population, and employing indoor residual spraying (IRS) within the households. This resulted in the dramatic reduction of malaria among the population of Rwanda (Habyarimana & Ramroop, 2020).

When a person/pupil gets sick, the treatment emergency is based on malaria symptoms and most of the time these

symptoms are dizziness, nausea, fever, and abdominal pain. In addition, headaches, vomiting, and body as well as muscle pain (Cohee et al., 2018).

3. Methodology

3.1 Research Design

This study adopted concurrent mixed methods research design. The study employed concurrently qualitative and quantitative methods. In this context, the concurrent mixed approach is used according to Gall and Borg (2010). Due to the nature of the intervention, the study was not blinded. The primary outcome was school attendance, assessed through routine daily attendance registers and spot checks conducted across the 16-month implementation period. Secondary outcomes were measured through repeat cross-sectional surveys (at baseline in 2015 and at follow-up in 2017) and included malaria parasitemia, anemia, educational performance, and parent-reported health-seeking behavior assessed through surveys with a selection of children (Boivin et al., 2019).

In the systematic review and meta-analysis, we searched the online databases PubMed, Embase, Cochrane CENTRAL, and Clinicaltrials.gov for intervention studies published between Jan 1, 2005, and Dec 30, 2019. We included randomized studies that assessed malaria's impact on school performance among children aged from 6 years old to 14 years. The systematic review and Meta-Analysis were done according to PRISMA guidelines.

3.2 Population and Sampling Techniques

The data surveyed was carried out in primary schools located in Kicukiro District. It is served by 57 public and private primary schools (Bødker R. et al.2016). The study covered a population of 3,308 stratified by social demographic types within class attendance.

Population (P): Children (primary school children) aged from 6 to 14 years old

Intervention/Exposure (I): Malaria

Comparison (C): None

Outcome (O): Academic performance

3.3 Research Instruments

Eligibility criteria:

Inclusion criteria

- Children: from 6-14 years
- Only studies done in Sub-Saharan Africa

- Studies on malaria in primary school of Rwanda
- Studies with confirmed diagnosis of malaria in Rwanda
- All study designs except systematic reviews and meta-analysis
- Only studies using English will be included
- Studies reporting academic performance as part of their outcomes

Exclusion criteria

- Narrative reviews and interventional studies
- Studies are done outside the study population and beyond sub-Saharan Africa

Search strategy

A highly sensitive search strategy was developed using the Ovid interface for MEDLINE and used to retrieve articles meeting the eligibility criteria. The search strategy included MeSH terms, text words, and entry terms and keywords of the PICO components of the research question. The following databases were searched including MEDLINE, EMBASE, ISI Web of Science, Scopus, CINAHL, Google Scholar, PsychINFO, AJOL, AMED, CAB International, and WHO Health Library. Using PubMed database keywords were developed and searched

Concept 1: Children "Child"[Mesh] OR Child* OR infant* OR "children under 14 years" OR "toddler" OR preschool

Concept 2: Performance "Academic performance or absenteeism or school attendance or malaria treatment or antimalarial"

Concept 3: malaria "malaria"[MeSH Terms] OR "malaria"[All Fields] OR "malaria"[All Fields] OR "malaria s"[All Fields] OR "malariae"[All Fields]"malaria" [Mesh] OR parasit* OR plasmodi* OR falciparum OR malaria [MeSH Terms].

"Child"[Mesh] OR Child* OR infant* OR "children under 14 years" OR "toddler" OR preschool AND Academic performance or absenteeism or school attendance or malaria treatment or antimalarial* AND "malaria"[MeSH Terms] OR "malaria"[All Fields] OR "malarias"[All Fields] OR "malaria s"[All Fields] OR "malariae"[All Fields] AND "malaria"[Mesh] OR parasit* OR plasmodi* OR falciparum OR malaria [MeSH Terms].

3.4 Validity and Reliability

Screening for eligibility

The retrieved articles were exported from all databases to Rayyan software for screening, duplication, and overall management of the retrieved records. We extracted study-level data without masking to author or publication and assessed the risk of bias in each study using Rev Man 5.2 software. For the study-level meta-analysis, we extracted the number of participants at individual-level data, including participant age, gender, anemia, clinical malaria status during follow-up and socioeconomic status. After searching the PubMed database, we had 102,718 articles. Using Rayann software, the studies were screened for eligibility according to our inclusion criteria. After screening for eligibility, we had 13 articles that fit our inclusion criteria

4. Results and Discussion

4.1 Description of Data

4.1.1 Data extraction and reporting

The data from included studies were extracted and quality appraisal was done using the standardized form. Researchers for studies that met the inclusion criteria using an Excel sheet did data extraction independently. Any discrepancies in data extraction were resolved by discussion and any further disagreement arbitrated by a reviewer. The information to be extracted included the name of the first author, year of publication, country, study design, study sample size, the prevalence of malaria, age of the study participants, and gender. Before

using the data extraction form, a pilot study was conducted with a selected sample of studies to evaluate the ability of the form to capture the listed study data of interest. Descriptive tables were used to summarize the literature and characteristics of studies included to generate the overall evidence.

4.1.2 Quality appraisal

The Effective Public Health Practice Project [EPHPP] (<http://www.ehphp.ca>) was used for quality appraisal. The following components of each included study were graded such as suitability of the study design for the research question, risk of selection bias, exposure measurement, outcome assessment, and generalizability of the findings. Overall grading for each study was derived from these component-specific assessments. Data were extracted for the first study using Pubmed and Revman 5.2 software as shown in figure 1. From 102,718 studies identified from database searches, 102,090 duplicate excluded, 628 screened, 591 excluded, 475 unrelated endpoints, 3 conducted before 2005, 17 participants symptomatic, 74 participants not aged between 6 and 14 years, 14 not sub-Saharan Africa, 4 only followed up parasite-positive participants, 4 same data in two or more articles, 37 reviewed in-depth: 24 excluded, 2 participants symptomatic, 6 participants not aged between 6 and 14 years, 2 same data in two articles, 1 treatment not randomized, 13 only followed up parasite-positive participants and was used in the final review.

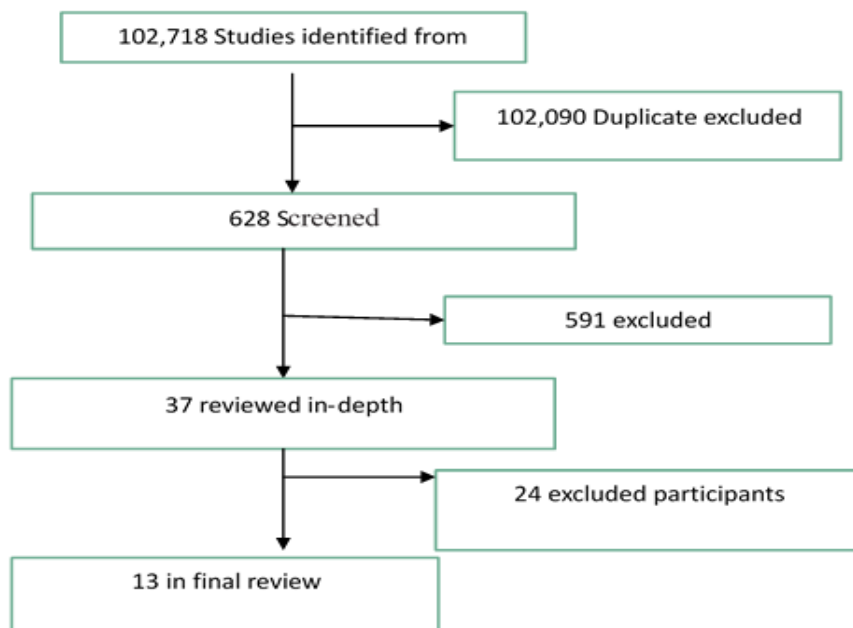


Figure 1: Data extraction for the 1st study using Pubmed and Revman 5.2 software

4.2 Discussion and Interpretation of findings

The data surveyed was carried out in primary schools located in Kicukiro District. It is served by 57 public and private primary schools. The study covered a population of 3,308 stratified by social demographic types within class attendance.

We were assessing the following research questions:

1. What is the impact of malaria on school attendance in Kicukiro primary schools?
2. What are the effects of malaria on students' performance at Kicukiro primary schools?
3. What is the healthcare-seeking behavior in Kicukiro primary schools?

Table 1: Schoolchildren programs, facilities, and absenteeism characteristics by study Control and Intervention group for selected schools in the study

School Characteristic	18 schools by control	39 schools by Intervention
No. of selected children (SD)	1103 (198.54)	2205 (793.8)
School program		
Feeding	6 (33.3%)	18 (46.2%)
Malaria control	12 (66.7%)	21 (53.8%)
School facilities		
Water and sanitation	7 (38.9%)	16 (41%)
Gender-separated toilets	11 (61.1%)	23 (59%)
School absenteeism		
Daily attendance	13 (72.2%)	15 (38.5%)
Field researcher record checks	5 (27.8%)	24 (61.5%)

In the above table, the school characteristics of selected children from 18 schools in control and 39 schools in intervention groups respectively show that 66.7% were recorded as malaria case-control while 53.8% were malaria intervention. These figures fall under the malaria cases found in East African schools where research conducted by Siff et al. (2016) disclosed that the prevalence of malaria in East African school-age children ranges from 1 -64 %. Equally important, in the whole of Africa malaria affects school-age children compared to the rest of the population (Makenga et al., 2020). The current research notices that due to school facilities, attendance was recorded for 38.9%, which is not the maximum, and it was pointed out by Halliday et al. (2020) that malaria causes school absenteeism in Africa where 50 % of this absenteeism can be prevented. In addition, other findings showed that 41% for water and sanitation, 61.1%, and 59% for gender-separated toilets in the control and intervention groups respectively.

Similarly, malaria negatively affects the students' performance in Kicukiro primary schools because during absenteeism students miss what other learners studied and teachers holistically evaluate matters delivered in the classroom. Komakech and Osuu (2014) have well highlighted that malaria disturbs the regular classes' attendance and stimulates pupils' absenteeism that negatively schools performance. The same situation was found in Nigeria where Gboeloh and Elele (2016) stressed that there is the absenteeism of students during illness and treatment that cannot allow the pupils to reach the level of regular pupils, hence negatively influencing the class performance. School attendance is known to be sensitive to contextual changes both at the school level, such as the introduction of a school feeding program, or the School facilities. Such changes are unavoidable and though monitored and broadly accounted for wherever possible, they may have exerted unobserved heterogeneity on the primary outcome of attendance.

Table 2: Children Age and Gender characteristics by study control and interventions

Child characteristics	1103 Children by Control	2205 Children by Intervention
Age in Years	Number of Children (%)	Number of Children (%)
6-8	235 (21.3%)	591 (26.8%)
9-11	245 (22.2%)	636 (28.8%)
12-14	623 (56.5%)	978 (44.4%)
Gender	Number of Children (%)	Number of Children (%)
Male	447 (40.5%)	998 (45.3%)
Female	656 (59.5%)	1207 (54.7%)

Table 2 shows that across all children attending the intervention schools, there were substantially more schools provided to female schoolchildren aged 6–14 years than to boys for any reason (59.5% vs 40.5%) for control and 54.7% vs 45.3% for intervention, despite intervention comprising more number of school children

than control (26.8% vs 21.3%; 28.8% vs 22.2% and 56.5% vs 44.4%) respectively of all enrolled children in 6-8, 9-11 and 12.14 age group. It is clear that from the intervention schools, girls had nearly twice the odds of attending at least one school than boys.

Table 3: Health care-seeking behavior and socioeconomic characteristics by control and intervention for selected children in the study

Characteristics	1103 Children by Control	2205 Children by Intervention
Health status		
Infection with <i>Plasmodium</i>	528 (47.9%)	998 (45.3%)
Anemia	575(52.1%)	1207 (54.7%)
Socioeconomic status		
Poorest	220 (20.0%)	398 (19.0%)
Poor	240 (22%)	391 (18.0%)
Median	199 (18.0%)	485 (21.0%)
Less poor	201 (18.0%)	389 (17%)
Least poor	243 (22.0%)	542 (25%)

The results from table 3 indicate that socioeconomic status by control leads for poor with 22% vs 18%, poorest with 20% vs 19% and less poor with 18% vs 17% of intervention respectively, while intervention comes for medium and least poor with 21% vs 18% and 25% vs 22% respectively. The intervention group was most likely to have children with anemia at school while the control group was most likely to have an infection with *Plasmodium*. These results agree with the research conducted by Halliday et al. (2020) who revealed that children who suffer from malaria also possess the

problems of anemia, which is a lack of blood, and it is very dangerous to the patient.

5. Conclusion and Recommendations

This paper presents estimates of the impact of malaria on schooling using data from primary schools in the Kicukiro district. The results of the intervention suggest the program provided a valued and well-used service, a finding validated by qualitative discussions and interviews with teachers, heads of schools, and parents'

representatives. In light of serious constraints to the health system in Rwanda, this is worthy of further investigation given the high and sustained uptake of the intervention and potential to shift workload away from already strained health centers. This trial found no overall impact of the school-based malaria case management program on school either absenteeism, health or education outcomes. Despite this, both the rate of uptake of the intervention and the results from a qualitative evaluation demonstrated that the program was in high demand and well perceived. In the final analysis, malaria stimulates students' absenteeism that implicates in pupils' poor performance.

References

- Cohee, L. M., Chilombe, M., Ngwira, A., Jemu, S. K., Mathanga, D. P., & Laufer, M. K. (2018). Pilot Study of the Addition of Mass Treatment for Malaria to Existing School-Based Programs to Treat Neglected Tropical Diseases. *The American journal of tropical medicine and hygiene*, 98(1), 95–99. <https://doi.org/10.4269/ajtmh.17-0590>
- Cook Gordon C. and Alimuddin I. Zumla, 2018. *Manson's Tropical Diseases*, 22nd Edition
- Gallup, J. L. & Sachs, J. D. (2017). The Economic Burden of Malaria. *American Journal of Tropical Medicine and Hygiene*, 64 (1, 2), 85–96
- Gboeloh, L. B., & Elele, K. (2016). Effects of malaria on school attendance among primary school pupils in Khana Local Government Area, Rivers State, Nigeria. *International Journal of Life Sciences and Technology*, 9(10):81-87
- Habyarimana, F., & Ramroop, S. (2020). Prevalence and Risk Factors Associated with Malaria among Children Aged Six Months to 14 Years Old in Rwanda: Evidence from 2017 Rwanda Malaria Indicator Survey. *International journal of environmental research and public health*, 17(21), 7975. <https://doi.org/10.3390/ijerph17217975>
- Halliday, K. E., Witek-McManus, S. S., Opondo, C., Mtali, A., Allen, E., Bauleni, A., Ndau, S., Phondiwa, E., Ali, D., Kachigunda, V., Sande, J. H., Jawati, M., Verney, A., Chimuna, T., Melody, D., Moestue, H., Roschnik, N., Brooker, S. J., & Mathanga, D. P. (2020). Impact of school-based malaria case management on school attendance, health and education outcomes: a cluster randomized trial in southern Malawi. *BMJ global health*, 5(1), e001666. <https://doi.org/10.1136/bmjgh-2019-001666>
- Karema, C., Wen, S., Sidibe, A., Smith, J. L., Gosling, R., Hakizimana, E., Tanner, M., Noor, A. M., & Tatarsky, A. (2020). History of malaria control in Rwanda: implications for future elimination in Rwanda and other malaria-endemic countries. *Malaria journal*, 19(1), 356. <https://doi.org/10.1186/s12936-020-03407-1>
- Komakech, R.A., & Osuu, J. B. (2014). Students' absenteeism: A silent killer of Universal Secondary School (USE) in Uganda. *International Journal of Education and Research*. 2(10), 417-436.
- Makenga, G., Menon, S., Baraka, V., Minja, D., Nakato, S., Delgado-Ratto, C., Francis, F., Lusingu, J., & Van Geertruyden, J. P. (2020). Prevalence of malaria parasitaemia in school-aged children and pregnant women in endemic settings of sub-Saharan Africa: A systematic review and meta-analysis. *Parasite epidemiology and control*, 11, e00188. <https://doi.org/10.1016/j.parepi.2020.e00188>
- Nankabirwa, J., Wandera, B., Kiwanuka, N., Staedke, S., G., Kanya, M, R., & Brooker, S, J. (2013). Asymptomatic Plasmodium infection and cognition among primary schoolchildren in a high malaria transmission setting in Uganda. *Am J Trop Med Hyg*, 88(6):1102-1108
- National Institute of Statistics of Rwanda, NISR. (2015). *Rwanda Demographic and Health Survey 2014–2015*. Kigali: National Institute of Statistics of Rwanda
- Nzabakiriraho, J. D., & Gayawan, E. (2021). Geostatistical modeling of malaria prevalence among under-five children in Rwanda. *BMC public health*, 21(1), 369. <https://doi.org/10.1186/s12889-021-10305-x>

- Orish, V., Amegan Aho, K., Ofori-Amoah, J., Osei-Yobah, J., Jamfaru, I., Afeke, I., Mac-Ankrah, L., & Adzaku, F. (2018). Asymptomatic Plasmodium falciparum infection and poor school performance in primary school children in the Volta Region of Ghana. *Ethiopian journal of health sciences*, 28(6), 749–758. <https://doi.org/10.4314/ejhs.v28i6.10>
- Percoco, M. (2018). The Fight against Geography: Malaria Eradication and Regional PMI. President is Malaria Initiative Rwanda Malaria Operational Plan FY 2018. 2017. <https://www.pmi.gov/where-we-work/rwanda>.
- Sift , K. C., Geus, D., Mukampungu, C., Mugisha, J. C., Habarugira, F., Fraundorfer, K., Bayingana, C., Ndoli, J., Umulisa, I., Karema, C., von Samson-Himmelstjerna, G., Aebischer, T., Martus, P., Sendegeya, A., Gahutu, J. B., & Mockenhaupt, F. P. (2016). Asymptomatic only at first sight: malaria infection among schoolchildren in highland Rwanda. *Malaria journal*, 15(1), 553. <https://doi.org/10.1186/s12936-016-1606-x>
- Vorasan, N., Pan-Ngum, W., Jittamala, P., Maneeboonyang, W., Rukmanee, P., & Lawpoolsri, S. (2015). Long-term impact of childhood malaria infection on school performance among schoolchildren in a malaria endemic area along the Thai-Myanmar border. *Malaria journal*, 14, 401. <https://doi.org/10.1186/s12936-015-0917-7>
- Weldesamuel, G. T., Alemayoh, T. T., Atalay, H. T., & Zemichael, T. M. (2019). Modern health-seeking behaviour and associated factors among mothers having under 5-years old children in Shire town, Tigray, Ethiopia: A cross-sectional study 2018. *African journal of primary health care & family medicine*, 11(1), e1–e6. <https://doi.org/10.4102/phcfm.v11i1.1913>
- World Health Organization, WHO. (2016). World Malaria Report 2018. Geneva: World Health Organisation
- World Health Organization Constitution of WHO. (2017). Principles. Viitattu: WHO
- World Health Organization, WHO. (2017). World Malaria Report 2017. Geneva, World Health Organization.
- World Health Organisation, WHO. (2020). World Malaria Report 2020: 20 years of global progress and challenges. Geneva: World Health Organisation. Licence: CC BY=NC=SA 3.0 IGO