Journal of Disease and Global Health

15(3): 48-53, 2022
ISSN: 2454-1842, NLM ID: 101664146

A COMPARATIVE STUDY OF THE DIFFERENT DIAGNOSTICS OF DETECTING MALARIA AND TYPHOID FEVER

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.56557/JODAGH/2022/v15i38060

Received: 22 October 2022
Accepted: 30 December 2022
Published: 31 December 2022

Original Research Article

ABSTRACT

Aim: The study is aimed at comparing the different method of diagnosing plasmodium parasite and typhoid fever and also to know the most effective method of diagnosis.
Methods: The different diagnostic method of analyzing malaria and typhoid were compared by using blood and stool samples of patients from Angwan Rogo community FCT, Abuja. The diagnostic method used for the analysis of malaria were Rapid diagnostic test kit (RDT) and microscopy diagnostic method, which are Field stain and Giemsa stain. The positivity rate of RDT was (12%), Field stain (88%) and Giemsa stain (94%). Typhoid fever was diagnosed using widal test and stool culture test. The results showed that age group 1-10 had the highest malaria prevalence of 70% followed by age group 21-30 with prevalence of 10%. The positive result for typhoid fever widal test is 63.3% while for stool culture is 90%.
Conclusion: The result of the study shows that children are more prevalent to malaria. Therefore, laboratory personnels should not depend solely on widal test, but rather they should employ other diagnostic method such as stool culture which can differentiate salmonella infections from other infections for more diagnostic test result.
In diagnosis of analysing malaria and typhoid, microscopy and stool culture are more accurate and reliable.

Keywords: Malaria; prevalence; typhoid fever; diagnostics; widal test.

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1. INTRODUCTION

Malaria is a mosquito-borne irresistible illness that influences people and different creatures. Malaria is brought about by single-celled microorganisms of the *Plasmodium* bunch. The sickness is most generally spread by a contaminated female Anopheles mosquito. The mosquito chomp presents the parasites from the mosquito's salivation into an individual's blood [1]. *Plasmodium* species are intracellular protozoan parasites of erythrocytes. The existence pattern of jungle fever parasites is intricate, with abiogenetic propagation happening in the mammalian host and sexual multiplication in the anopheline mosquito vectors [2]. The parasites travel to the liver where they develop and imitate. Five types of Plasmodium can taint and be spread by people [3]. Most passings are brought about by P. falciparum, though *P. vivax, P. ovale, P. malariae* and some of the time *P. knowlesi* for the most part can cause intense, serious disease yet death rates are low. Anopheles gambiae, Anopheles funestus, Anopheles arabiensis, and Anopheles moucheti are the significant vectors that cause all year transmission [4]. Side effects of malaria fever, tiredness, vomiting, and headaches. Yellow skin, seizures, coma, or or passing can be caused in serious cases [1]. Indications generally start ten to fifteen days in the wake of being chomped by a contaminated mosquito [3]. It is accepted that the historical backdrop of jungle fever episodes returns to the beginnings of development. It is the most broad illness because of which many individuals have lost lives and is even idea to have been the reason for significant military losses, just as the vanishing of certain countries [5].

In Nigeria, intestinal sickness is endemic and is the main irresistible illness in tropical and subtropical areas, and keeps on being a significant worldwide medical condition. The most defenseless are people with no or little insusceptibility against the sickness. In regions with high transmission the most weak gatherings are kids, pregnant ladies, transients or voyages coming from places with no or little intestinal sickness transmission [6]. The commonness of openness to intestinal sickness contamination in pregnancy was most noteworthy in the West African sub-area and Central Africa (each with 35%) in 2018, trailed by East and Southern Africa (20%). About 39% of these were in the Democratic Republic of the Congo and Nigeria. The pregnant ladies presented to jungle fever contamination were around 11 million and around 872 000 kids were conveyed with low rate of birth, with West Africa having the most elevated commonness of low birth weight youngsters because of intestinal sickness in pregnancy. The sickness compromises over 40% of the total populace, causing 229 million cases and 410,000 passings each year [7]. Patients giving a febrile ailment in endemic regions are probably going to be determined to have intestinal sickness. The essential procedures utilized for diagnosing intestinal sickness are microscopy technique and fast test indicative testing [8].

Intestinal fever, alluding to typhoid fever and paratyphoid fever, is a typical bacterial sickness with high grimness and death rates [9]. The World Health Organization (WHO) gauges up to 21 million intestinal fever cases and 161,000 passings every year around the world. There are an expected 11–21 million instances of typhoid fever and roughly 128 000–161 000 passings every year, contrasted with an expected 6 million instances of paratyphoid fever and 54 000 passings yearly . Human-limited Salmonella enterica serovars *Typhi* and *Paratyphi* A, B, and C (*S. typhi* and S. paratyphi A, B, and C) are the reason for intestinal fever. *Salmonella* enterica serovar *typhi* (*S. Typhi*) and *S. Paratyphi* an are the Gram-negative microorganisms (Salmonella serovars are sent through the waste oral course after the ingestion of defiled food and water. The hatching time of intestinal fever is around 8–14 days . The length and seriousness of the illness are influenced by the kinds of bacterial strains and portions just as host insusceptible reactions [10]. Typhoid fever is an intense, perilous, febrile disease. Without treatment, the case casualty pace of typhoid fever is 10–30%, dropping to 1–4% with suitable treatment [11] Small kids are at most serious danger. Normal indications incorporate supported fever, chills and stomach torment. The vague indication profile confounds clinical analysis, with side effects that are normal to different illnesses happening in typhoid-endemic regions [12].

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in Angwan Rogo FCT Abuja, Nigeria.

2.2 Sample Collection

A sterile clean container was used to collect stool samples from the patients and urine contaminants was avoided. Blood samples were also collected and inserted into an EDTA (Ethylene Diamine Tetra-acetic Acid) bottle.

2.3 Materials

Ethylene Diamine Tetraacetic acid (EDTA) blood bottles, Field A and B, 5 mL syringes and Giemsa stains, microscopic slides, light microscope

,RDT(Rapid Diagnostic Tests) kits , cover slip, colonical flask, cotton wool, methylated spirit sterile container for stool sample, wireloop, petric dish, Salmonella Shigella Agar (SSA).

2.4 Malaria Diagnositic Tests

2.4.1 Giemsa stain

Blood samples were collected and put in an EDTA sterile bottle.Smears were made on the sterile glass slide and allowed to dry quickly at room temperature. The slides were stained with working Giemsa stain for one hour. The smeared slides were rinsed by dipping 5 times in the Giemsa buffer and were dried upright in the rack.

2.4.2 Field stain

Blood smears were made on clean glass slides and dried in air. The slides were dipped in Field Stain A (Blue stain) for 5-6 seconds and in field B for (pink stain) for 5-6 seconds. The slides were washed in a cup containing water. The slides were dried and viewed under oil immersion Objectives.

2.4.3 Widal test

Widal test can be done in two ways: Rapid test on slide and Tube test, but the rapid slide test was used in this work.

2.4.5 Rapid slide test

The test card supplied in the kit was well labelled. Circles (1, 2, 3, 4, 5 and 6) in the test card were labelled as O, H, Ah, BH, Negative control and positive control. A drop of undiluted test serum was placed in each of the four labelled circles (1, 2, 3 and 4) and the negative and positive circles. Antigen O, H, AH, BH drop were placed in the circles 1, 2, 3, 4 respectively and no antigen in circles 5 and O/H antigen in circle 6. The content in the circles were mixed with separate applicator stick and spread fill the whole area of the individual circle. The test card was rocked for a minute and observed for agglutination.

2.4.6 Stool culture

A stool culture is a test that detects and identifies bacteria or viruses that causes infection of the lower intestinal tract. The test differentiates between the pathogenic organisms (for example, Campylobacter, Shigella, Salmonella, Yersina and Vibrio.

2.4.7 Macroscopic examination

The physical examination of stool was examined, in carrying out the analysis of stool.

i. The appearance of the stool.
ii. The stool was examined to know if it was formed, semi-formed or unformed, fluid or watery.

2.4.8 Microscopic examination

Microscopic examination of stool involves the use of microscope in analyzing the stool sample.

An aliquot portion of the sample was collected using the applicator stick and emulsified in normal saline, a small amount of stool was drop on a grease free slide. A thin preparation was made on a glass slide and covered using the cover slip. The preparation was adjusted and focused on the microscope using the ×10 objective lens; it was viewed after closing the condenser iris for good contrast.

2.4.9 Preparation of medium Salmonella Shigella Agar (SSA Agar)

The salmonella shigella agar was prepared according to manufacturer's description and sterilize in the autoclave at pressure saturated steam of 121°c for 15 minutes. The sterilized medium was carefully dispensed into sterilized plates laid out on a leveled surface, where it was allowed to cool and solidify.

2.4.10 Stool culture

A sterile wireloop was used to collect an aliquot portion sample. The sample was smeared on the prepared agar (Shalmonella shigella) and covered immediately. The cultured plates were incubated at 37oC for 24 hours. The plates were checked for growths.

2.4.11 Gram stain

A sterile wireloop was used to collect colonies and smeared on different clean glass slides and allowed to dry and heat fixed. Giemsa stain was used to flood the slide and allowed to stay for 60 seconds and rinsed with water. Iodine was used to flood the slide after 60 seconds, water was used to rinse the slide. After, alcohol was used to flood the slide then rinsed off with water after 2 seconds and safranin was then used and after 60 seconds was rinsed with water.

3. RESULTS

The total number of blood and stool samples collected from Angwan Rogo community FCT Abuja, were 50 and 30 samples. Women and children were the major

participants. Age 1-10 had the highest. Out of the 50 samples, age group of 1-10 had the highest prevalence of 70%, followed by age group 21-30 with prevalence of 10%. The highest positivity of malaria diagnostic test was 94% from Giemsa stain with 6% negativity, Field stain positivity with 88% with 12% negativity and 12% positivity with 88% negativity for Rapid Diagnostic Test (RDT). In typhoid test the age group 10-20 should have the highest prevalence of typhoid fever, followed by age group 31-40 with prevalence of 33.3% and age group 21-30 has the prevalence of 13.3%. The positive result for both widal and stool culture test were 63.3% and 90% and the negative result was 36.7% and 80%.

Table 1 this describes the positivity and negativity of malaria diagnostic test, rapid stain has a positivity of 12% and negativity of 88%, field stain had a positivity of 88% and 12% negativity, and Giemsa stain has the highest positivity of 94% and 6% negative result.

Table 2 the age distribution and prevalence of malaria in this study, shows that age group 1- 10 has the highest prevalence of (70%) , followed by age group 21-30 with the prevalence of (10%), (8%) and (6%) prevalence was seen at age groups 11-20 and 31-40.

Table 3 typhoid fever diagnostic method shows the highest positivity of 90% in the stool culture test and 80% negativity, while for widal test there is 63.3% positivity and 36.7% negativity in the study.

Table 4 The prevalence of the age group 10-20 was (40%), this age group were more susceptible to the disease. The age group 21-30 had the prevalence of (13.3%) and (33.3%) were the prevalence of age group 31-40.

Table 1. Comparative analysis of malaria diagnostic tests
NO=50

	No positive (%)		
	Rapid test	**Field stain**	**Giemsa stain**
Positive	6 (12%)	44 (88%)	47 (94%)
Negative	44 (88%)	6 (12%)	3 (6%)

NO--- Number
(%) -- Percentage

Table 2. The relationship between prevalence of malaria and age distribution
NO= 50

Age group	Rapid test	Field stain	Giemsa stain (%)	Prevalence
1-10	4	32	35	(70%)
11-20	1	4	4	(8%)
21-30	0	5	5	(10%)
31-40	1	3	4	(6%)

NO--- Number

Table 3. Comparative analysis of typhoid diagnostic test
NO=30
NO POSITIVE (%)

	Widal test	Stool culture test
Positive	19 **(**63.3%)	27 (90%)
Negative	11 **(**36.7%)	24 (80%)

No---Number
(%) --Percentage

Table 4. The relationship between prevalence of typhoid fever and age distribution

Age group	Widal test	Stool culture	Prevalence (%)
10-20	9	12	(40%)
21-30	2	4	(13.3%)
31-40	8	10	(33.3%)

4. DISCUSSION

The findings of the study shows that age 1-10 has the highest malaria prevalence at 70%, followed by age 21-30 with prevalence of 10%, showing that malaria is high among children and least among adults. This is due to the fact that children are yet to develop the necessary immunity to defend themselves against the disease. In the diagnosis of malaria the positivity rate of rapid test (RDT) was (12%), Field stain (88%), Giemsa stain (94%) observed in (Table 1). This means that Giemsa stain is more accurate than field stain and rapid stain. This corresponds with the work of [13] which showed that the stained film microscopy showed more positivity than the Rapid Diagnostic Test kits which is consistent with that of this study but these contradicts the results of the study carried out by [14] which may be due to different Rapid Diagnostic Test kits. World Health Organization currently made the recommendation that parasite-based diagnosis should be used in all cases of suspected malaria [15] . You have to be very conscientious, because this test is expensive.

The prevalence of typhoid from age 10-20 is 40% followed by age 31-40 which showed the prevalence of 33.3%. Stool culture has the highest positive rate of (63.3%) while the positive rate for widal test is (90%). Results from this study also showed that people of all ages are susceptible to infection by *S. typhi*. The age group more susceptible to the present study were those between 10-20 years old. Widal test has its limitations which makes it unreliable. The Widal test is time consuming (to find antibody titre) and often times when diagnosis is reached it is too late to start an antibiotic regimen, The test may be falsely positive in patients who have had previous vaccination or infection with *S. typhi*, Besides cross-reactivity with other Salmonella species, the test cannot distinguish between a current infection and a previous infection or vaccination against typhoid, In low typhoid endemic areas, weak and delayed O and H antibody responses limit the usefulness of the Widal test, Variations also exist between laboratories in the performance and reading of Widal tests which compromise further the reliability of the test. The World Health Organization (WHO) has said that due to the various factors that can influence the results of a Widal test, it is best not to rely too much on this test. The results from this study concur with the study carried out by [16,17,18]. which showed that those between 24-29 years were more susceptible to typhoid fever. The most effective diagnostic method for the analysis of typhoid is the stool culture test, while for malaria diagnosis is the microscopy method.

5. CONCLUSION

Malaria which is endemic in Nigeria is a major threat to human health, it should be diagnosed with accurate methods such as microscopy diagnostic method. Laboratory workers should not rely on rapid test kits, because it could give false results. Malaria diagnostic test stains such as field stain and giemsa stain should be incorporated in the diagnosis of the disease.

Similarly typhoid fever is also an endemic disease which calls for a concern in the health sector. The widal diagnostic test is not very reliable, prompt and accurate because, it is highly sensitive rather than specific and gives a false result, it cannot distinguish between a current infection and a previous infection or vaccination against typhoid, when previous antibiotic treatment has being taken. Therefore, laboratory personnels should not depend solely on widal test, but rather they should employ other diagnostic method such as stool culture which can differentiate salmonella infections from other infections for more diagnostic test result.

This is very essential for all laboratory personnel to be abreast with the most effective and efficient diagnostic methods of malaria and typhoid fever.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organization. Malaria Fact sheet N° 94; 2014.
[cited Jul 20 2021]
Available:https://reliefweb.int/report/world/malaria-fact-sheet-no-94-updated-march-2014
2. Cowman AF, Healer J, Marapana D, Marsh K. Malaria: Biology and Disease. Cell. Biology and disease. 2016;167(3):610-24.
DOI: 10.1016/j.cell.2016.07.055, PMID 27768886.
3. Caraballo H, King K. Emergency department management of mosquito-borne illness: malaria, dengue, and West Nile virus. Emerg Med Pract. 2014;16(5):1-23; quiz 23. PMID 25207355.
4. Sinka ME, Bangs MJ, Manguin S, Rubio-Palis Y, Chareonviriyaphap T, Coetzee M et al. A global map of dominant malaria vectors. Parasit Vectors. 2012;5:69.
DOI: 10.1186/1756-3305-5-69, PMID 22475528.

5. Moss W, Shah S, Morrow R. The history of malaria and its control. International Encyclopedia. Public Health. 2018:389-98.
6. Center for disease control. Malaria's impact worldwide; 2019.
[Cited Jul 8 2021].
Available:https://www.cdc.gov/malaria/malaria_worldwide/impact.html
7. World Health Organization. 20 years of global progress and challenges; 2020.
[Cited Jul 14 2021].
Available:https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2020
8. Nelson B, Izadnegahdar R, Hall L. Global health fellowships: A national, cross-disciplinary survey of US training opportunities. J Gradration Med Educ. 2012;4(2):184-9.
9. Michael L, Wilson M. Laboratory diagnosis of malaria: conventional and rapid diagnostic methods. Arch Pathol Lab Med. 2013;137(6):805-11.
DOI: 10.5858/arpa.2011-0602-RA, PMID 23721276.
10. Wilson ML. Laboratory diagnosis of malaria: conventional and rapid diagnostic methods. Arch Pathol Lab Med. 2013;137(6):805-11.
DOI: 10.5858/arpa.2011-0602-RA, PMID 23721276.
11. World Health Organization. World malaria report; 2019.
[Cited Jul 13].
Available:https://www.who.int/publications-detail/worldmalaria-report-2019
12. Perkins DJ, Were T, Davenport GC, Kempaiah P, Hittner JB, Ong'Echa JM. Severe malarial anemia: innate immunity and pathogenesis. Int J Biol Sci. 2011;7(9):1427-42.
DOI: 10.7150/ijbs.7.1427, PMID 22110393.
13. Udechukwu C, Onyali I. Comparative analysis of different diagnostic techniques for Plasmodiasis. Niger J Parasitol. 2010;31(2).
DOI: 10.4314/njpar.v31i2.69478
14. Innocent C, Omalu G, Israel K, Charles M, Suleiman H, Victoria P et al. Evaluating the use of microscopic examination and rapid diagnostic tests to diagnose malaria in NorthCentral Nigeria. Malar Rep, 6. 2014;4381:2039.
15. Azikiwe CC, Ifezulike CC, Siminialayi IM, Amazu LU, Enye JC, Nwakwunite OE. A comparative laboratory diagnosis of malaria: microscopy versus rapid diagnostic test kits. Asian Pac J Trop Biomed. 2012;2(4):307-10.
DOI: 10.1016/S2221-1691(12)60029-X, PMID 23569920.
16. Perkins DJ, Were T, Davenport GC, Kempaiah P, Hittner JB, Ong'Echa JM. Severe malarial anemia: innate immunity and pathogenesis. Int J Biol Sci. 2011;7(9):1427-42.
DOI: 10.7150/ijbs.7.1427, PMID 22110393.
17. Uneke CJ. Concurrent malaria and typhoid fever in the tropics: the diagnostic challenges and public health implications. J Vector Borne Dis. 2008;45(2):133-42. PMID 18592842.
18. Cao XE, Kim J, Mehta S, Erickson D. Two-color duplex platform for point-of-care differential detection of malaria and typhoid fever. Anal Chem. 2021;93(36): 12175-80.
DOI: 10.1021/acs.analchem.1c03298, PMID 34469115.