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Original Research Article

Prevalence of Malaria and Typhoid Fever Co-Infection among Patient Attending Murtala Muhammad Specialist Hospital, Kano

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Abstract: Malaria and typhoid fever are major aetiological considerations in both acute and prolonged fever of unknown origin (PUO) in the tropics and sub-tropics where opportunities for transmission are wide-ranging. Because of the high prevalence of malaria and typhoid fever in Nigeria, co-infections are common. A cross-sectional study was conducted to determine the prevalence of malaria and typhoid fever co-infection among patient attending Murtala Muhammad Specialist Hospital, Kano. Structural questionnaire were administered to obtain socio – demographic data. A random sampling was done and the estimated sample size is 110, which involved both male and female. Two ml of venous blood sample was collected for malaria and typhoid test. Conventional Widal tests for the detection of Salmonella spp were done as well as blood film preparation for detection of Plasmodium spp. The study show high overall prevalence of malaria 67(60.9%) and typhoid 74(67.3%), the co-infection prevalence 60(54.5%) was equally high. Co-infection rate in females 33(60.0%) was higher ($p<0.05$) than males 27(49.1%). The non-educated patients had the highest co-infection rate of 30(78.9%). The co-infection rate is higher ($p<0.05$) among the poor subjects 47(61.8%) than rich participants 13(38.2%). Of the total number of patients age ranging from 1–15 had the highest malaria prevalence of 22 (73.3%) while 61–75 has the least malaria prevalence of 4 (44.4%). On the other hand age ranging from 16–30 had the highest typhoid prevalence of 30 (73.1%) while age range from 61–75 had the least typhoid prevalence of 4(44.4%) ($p<0.05$). Therefore, there is need to step up sensitization on malaria and typhoid prevention. Other diagnostic tests such as molecular techniques and blood culture should be employed to determine the sensitivity and specificity of Widal and microscopy methods.

Keywords: Malaria, Typhoid, Co-Infection, Rural Area, Kano, Nigeria.

INTRODUCTION

Malaria and typhoid fever are endemic diseases with life threatening consequences especially in tropics and sub-tropics where opportunities for transmission are wide-ranging. About 229 million cases of malaria were diagnosed, with 405,000 attributable deaths in 2019 in 87 malaria endemic countries (WHO, 2020). About 95%

of malaria deaths globally were in 31 countries: Nigeria (23%), the Democratic Republic of Congo (11%), the United Republic of Tanzania (5%), Mozambique (4%), Niger (4%) and Burkina Faso (4%) accounted for about 51% of all malaria deaths globally in 2019 (USAID, 2017; WHO, 2020).. Globally World Health Organization estimates the burden of typhoid fever to about 11-20 million cases, leading to about 128,000–161,000 deaths per year (WHO, 2018). Similar socio-epidemiological factors and dynamics such as dense populations with poor hygiene and sanitation practices usually influence the predisposition to malaria and typhoid fever co-infection (Iheukwumere *et al.,* 2013). Malaria infection is caused by the *Plasmodium* parasite (*P. falciparum*, *P. vivax*, *P.* malariae and *P. ovale*) through the bite of female anopheles mosquito. However *P. falciparum* is the most common causative agent and contributes to the highest fatality (Kargbo, *et al.,* 2014).

At the same time, typhoid fever and paratyphoid fever, are commonly caused by *Salmonella enterica* (*S. enterica*) serovar Typhi and *S. enterica serovar* Paratyphi (A, B and C) and common in malaria-endemic settings resulted in 11 to 20 million cases and 20,000 deaths (Ajibola *et al.,* 2018). Isolation of the causative bacteria in typhoid fever patients by culture remains the gold standard for diagnosis (Ajibola *et al.,* 2018). However, in most developing countries a serological test especially "Widal" test is most commonly applied (Ajibola *et al.,* 2018). Kano is one of the densely populated states in Nigeria where a study by Abdulkarim and Mohammed (2017) reported about 1,225 cases of typhoid fever within five years in a single hospital in Kano State, Nas *et al.,* (2017) also reported an 18% prevalence of typhoid fever in Kumbotso local government area of Kano state. This study is conducted to determine the prevalence of malaria and typhoid fever co- infection among patients attending Murtala Muhammad specialist hospital (MMSH), Kano State, Federal Republic of Nigeria.

MATERIALS AND METHODS

Design of the Study

A cross-sectional experimental study was carried out to determine the prevalence of malaria and typhoid fever co-infection among patients attending MMSH, Kano.

Study Area

The study was conducted among patients attending General out patients department MMSH, Kano. The hospital lies on Latitudes 11.9634° N, 8.5504° E. The indigenes are predominantly Fulani and Hausa by tribe.

Study Population

The study population comprised of 110 patients with clinical signs and symptoms suggestive of malaria or typhoid fever with request of either Malaria parasite or Widal test from Physicians at MMSH, Kano.

Ethical Consideration

Ethical approval was soughed and obtained from the ethical committee, Kano State Ministry of Health.

Questionnaire Administration

A structured questionnaire was administered to obtain demographic characteristics and risk factors associated with Malaria and Salmonella infections among the study participants.

Sample Collection and Transportation

Using a sterile syringe, exactly two ml of blood from each consented patient was aseptically collected in a plain container and transported to the laboratory for further analysis.

Widal Agglutination Test

Widal slide agglutination test was done using *S. typhi, S. paratyphi* A, *S. paratyphi* B and *S. paratyphi* C O and H antigens according to the instructions of the manufacturer (Chronolab systems).

Thick Blood Film Preparation

Each blood sample was mixed thoroughly and gently. A large drop of blood was placed on a clean grease free glass slide. Using the end of a plastic spreader the drop of blood was spread to make an even thick smear such that news prints can be read under it. This was labeled and air-dried before staining (Cheesbrough, 2009).

Thin Blood Film Preparation

A drop of blood was placed on one end of a clean grease free glass slide. Using a smooth edged slide spreader, the drop of blood was spread to make a thin film. The film was labeled and air-dried before staining (Cheesbrough, 2009).

Staining of Blood Films Using Fields Stain A and B

Each dried thick blood film was dipped into Field's stain A for 5 seconds. The excess stain was drained off by touching a corner of the slide against the side of the container. This was then washed in distilled water. The slide was dipped into Field's stain B for 3 seconds and then washed in distilled water. The back was wiped and air dried. Each thin film was fixed in methanol then covered with Field's stain B. An equal volume of Field's stain A was added immediately and mixed. This was allowed to stain for

1 minute, washed with distilled water and allowed to air dried (Cheesbrough, 2009).

Microscopy

The stained slide was placed on the stage in the microscope, the stage was lowered to the maximum distance from the objective revolver with the aid of coarse adjustment, a drop of oil immersion was placed on the slide and the results were observed and recorded (Ochei and Kolhatkar, 2000).

Statistical Data Analysis

Chi-square and students t-test statistical tools were used to analyze the data with limiting error at 0.05 as indicator of statistical significance.

RESULT

A total of One Hundred and Ten (110) participants took part in this study which comprises 55 males and 55 females with ages ranging from 1–75 years, more participants were in the age group 16–30years and the least were in the age group 61–75years (Table 1).

Prevalence of Malaria and Typhoid Fever in Relation with the Socio-Demographic Factors of the Participants

Out of 110 participants analyzed, the total prevalence of malaria was 60.9% (67) (Table 1). Females had a malaria prevalence of 70.9% (39), significantly higher than males 50.9% (28) ($p < 0.05$) (Table 1). Age group ranging from 1–15 years had the highest malaria prevalence rate of 73.3% (22) while age group 61–75 recorded the least malaria prevalence rate of 44.4% (4). Based on level of education, informally educated participants had the highest malaria prevalence of 78.9% (30) and subject with secondary level of education had the least malaria prevalence rate of 39.5% (15) but the difference between the age groups was statistically significant ($p < 0.05$). According to residential area of the participants, rural dwellers had the highest malaria prevalence rate of 67.1% (55) than urban dwellers 42.9% (12) ($p < 0.05$). In relation to socioeconomic status of the patients, low income earners had a malaria prevalence rate of 72.4% (55), significantly higher than middle income earners 12(35.6%) ($p < 0.05$) (Table 1). On the other hand, 67.3% (74) of the participants had typhoid fever (Table 1). The prevalence of typhoid in males was 61.8% (34) and the one in female was 72.7% (40), but there was significant difference among the sexes ($p < 0.05$) (Table 1). Generally, patients of the age group 16-30 years had the highest prevalence of 73.1% (30) and the least infected were of the age group 61–75 years with prevalence of 44.4% (4) and there was a significant difference in the infection rate between the different age groups ($p < 0.05$) (Table 1). In terms of education level, patients with non-formal education status had higher incidence of typhoid fever 89.5% (34) and participants with primary education as the highest level of education had 38.9% (7) prevalence of typhoid fever but a significant different exist between the levels of education ($p < 0.05$). Furthermore, rural dwellers had higher typhoid incidence 69.5% (57) compared to urban dwellers incidence rate of 60.7% (17). Low income earn participants had higher typhoid prevalence rate of 78.9% (60) than middle income earn participants who had typhoid prevalence rate of 41.2% (14). However, place of residence and socioeconomic status of the participants are significantly related with typhoid fever ($p < 0.05$) (Table 1).

Variation in Co-Infection of Malaria and Typhoid Fever with Respect to Socio-Demographic Characteristics of the Participant

The overall prevalence of malaria and typhoid co-infection was 54.5% (60) (Table 2). Female had the highest co-infection rate of 33(60.0%) than male 27(49.1%). Generally, age group 31–45 had the highest co-infection rate of 14(75.0%) while 61–75 age grouped had the least co-infection rate of 4(44.4%). Non-formally educated participants had the highest co-infection rate of 30(78.9%) and high institution had the least co-infection rate of 5(31.5%). Rural dwellers had a higher co-infection rate of 48(58.5%) than urban dwellers with co-infection incidence of 12(42.9%). Low income earn participants had the highest co-infection rate of 47(61.8%) while middle income participants had the co-infection rate of 13(38.2%). The correlation showed that gender, age, level of education, place of residence and socioeconomic status of the study subject were significantly ($p < 0.05$) related with malaria and typhoid co-infection (Table 2).

DISCUSSION

Malaria, typhoid fever and their co-infection are public health problems in sub-Saharan African countries being a potentially fatal and multi systemic infectious diseases (Mehta *et al,* 2017). Malaria and typhoid are known to present similar symptoms and their diagnosis is complicated more especially in low-income countries (Crump and Kirk, 2015). Prevalence of typhoid have been influence by socio-demographic factors and it mainly affect children and young adults whereas in developed nations it is primarily a disease of returning travellers (Deksissa and Gebremedhin, 2019). Malaria and typhoid are endemic in Nigeria and this pose the high risk of contracting both diseases (Ukaegbu *et al.,* 2014).

From our study, the overall prevalence of malaria 67(60.9%) and typhoid fever 74(67.3%)

were quite high, this could probably be due to the fact that the area is endemic with high and perennial transmissions of malaria and typhoid, and also most people are ignorant of causative agents, means of transmission, spread and acquisition of the disease. The prevalence obtained from this study was higher than the study carried out in Jos, Plateau state, Nigeria, which showed the prevalence rate of malaria (54%) and typhoid fever (42%) (Ukaegbu *et al*., 2014). On the other hand, prevalence of malaria obtained in this study was less than (80.8%) for malaria and higher than (46.8%) for typhoid fever respectively as reported by (Akung *et al.,* 2016). Differences in prevalence could be due to differences in Widal test kits used, seasonal variations during which the study was carried out, and differences in cultural practices especially with respect to hand washing as well as availability of toilet facilities.

Typhoid fever higher prevalence among the febrile patients in this study showed that typhoid is more likely to cause febrile illness than malaria among the study subjects. This is not in consonance with the report by (Ukaegbu *et al.*, 2014) who observed 54% of malaria against 23.26% of typhoid and 50.4% of malaria against 4.7% of typhoid fever in Ibadan (Igbeneghu *et al.*, 2009). Also, findings by Tadesse and Tadesse (2013) suggest that malaria is more prevalent among febrile patients at 51.5% against 10.3% of typhoid fever. These variations could be due to the diagnostics test used in detecting typhoid in these studies and other environmental factors such as poor sanitary hygiene. Widal test which is the commonest diagnostic test used in the confirmation of typhoid fever in most low- income areas, Nigeria not excluded has been said to have low sensitivity and specificity which could lead to a false positive or false negative result (Olopoenia and King,2000; Akinade *et al.,* 2015). In support of this findings, some studies report a high prevalence of typhoid fever than malaria backing results from this study (Igharo *et al.,* 2012).

Table 1: Prevalence of malaria and typhoid fever in relation with the socio-demographic factors of the participants

Parameters	M	F	Total	No. examined	No. of malaria positive%	No. of typhoid positive%	Level of Significance
Sex	55	55	110	110	67(60.9%)	74(67.3%)	*χ^2 = 1.23* P = 0.046
Age range							
1 – 15	18	12	30	30	22(73.3%)	21(70.0%)	
16 – 30	16	25	41	41	28(68.3%)	30(73.1%)	
31 – 45	8	12	20	20	9(45.0%)	13(60.0%)	*χ^2 = 1.18*
46 – 60	6	4	10	10	4(40.0%)	6(60.0%)	P = 0.047
61 – 75	7	2	9	9	4(44.4%)	4(44.4%)	
Total	**55**	**55**	**110**	**110**	**67(60.9%)**	**74(67.3%)**	
Level of education							
Primary	10	8	18	18	12(66.7%)	7(38.9%)	
Secondary	19	19	38	38	15(39.5%)	20(52.6%)	
Higher Institution	10	6	16	16	10(62.5%)	13(81.3%)	*χ^2 = 2.03*
Non formally educated	16	22	38	38	30(78.9%)	34(89.5%)	P = 0.051
Total	55	55	110	110	**67(60.9%)**	**74(67.3%)**	
Residential area							
Urban dwellers	18	10	28	28	12(42.9%)	17(60.7%)	*χ^2 = 0.99*
Rural dwellers	37	45	82	82	55(42.9%)	57(69.5%)	P = 0.024
Total	**55**	**55**	**110**	**110**	**57(60.9%)**	**74(67.3%)**	
Socio-economic status							
Middle income eaners	16	18	34	34	12(35.6%)	14(41.2%)	*χ^2 = 1.11*
Low income earners	39	37	76	76	55(72.4%)	60(78.9%)	P = 0.013
Total	**55**	**55**	**110**	**110**	**67(60.9%)**	**74(67.3%)**	

Chi Square = X^2, Probability value = *p*-value, Confidence Interval = 95%

The prevalence of malaria was higher in females 39(70.9%) than males 28(50.9%), this is similar to reports from Ethiopia by (Birhanie *et al.,* 2014) and in Sierra Leone (Sundufu *et al.,* 2012). This finding is not the same with the study by (Akung *et al,* 2016) who reported high prevalence of malaria in males (85.8%) than females (76.6%). The prevalence of typhoid fever was greater in female 40(72.7%) than males 34(61.8%). This is in agreement with the slightly higher prevalence rate of 64.2% among females compared to males (63.6%) in Wukari reported by Odikanmoro *et al*., 2017 but at variance with Sale *et al*., 2020 who obtained a total of 45 (46.9%) of males and 33 (31.7%) of females typhoid fever positivity rate. This suggests that females may be more prone to the disease. Females may acquire infection from unhygienic environment, during child care, improper food preparation and other household activities, thus increasing the frequency of typhoid fever. With regard to age groups, the age group of 1–15years had the highest prevalence of malaria 22 (73.3%) while 61–75 years had the least 4(44.4%). However, the study was in contrast with the study of (Akung *et al.,* 2016). This is closely similar to the popular view that children less than 10 and those 11-20 years of age have higher prevalence rates. On the other hand, the study is in agreement with Anthony *et al.*, 2008. Those within the age group of 16 – 30 years had the highest prevalence rate of typhoid fever 30(73.1%) while 61 – 75 years has the least 4(44.4%). This is in contrast with the report of (Okore *et al.,* 2015) and (Akung *et al.,* 2016).

Table 2: Variation in co-infection of malaria and typhoid fever with respect to socio-demographic characteristics of the participants

Parameters	No. examined	No. of malaria & typhoid positive%	Level of significance
Sex			
Male	55	27(49.1%)	P = 0.042
Female	55	33(60.0%)	
Total	**110**	**60(54.5%)**	
Age group			
1 – 15	30	16(53.3%)	P = 0.044
16 – 30	41	20(48.8%)	
31 – 45	20	14(75.0%)	
46 – 60	10	6(60.0%)	
61 – 75	9	4(44.4%)	
Total	**110**	**60(54.5%)**	
Level of education			
Primary	18	10(55.6%)	P = 0.037
Secondary	38	15(39.5%)	
Higher institution	16	5(31.3%)	
Non – formally educated	38	30(78.9%)	
Total	**110**	**60(54.5%)**	
Residential area			
Urban dwellers	28	12(42.9%)	P = 0.054
Rural dwellers	82	48(58.5%)	
Total	**110**	**60(54.5%)**	
Socio-economic status			
Middle income earners	34	13(38.2%)	P = 0.033
Low income earners	76	47(61.8%)	
Total	**110**	**60(54.5%)**	

Chi Square = X^2, Probability value = *p*-value, Confidence Interval = 95%

Based on the finding of the present study, non-formally educated, rural societies and low income earn participants recorded higher prevalence of malaria and typhoid fever over their counterparts. This findings is similar to Okolo *et al*., 2023 who revealed higher malaria prevalence among those from rural area 4(66.7%) than those from urban area 2(33.3%) and agreed with Haruna *et al*., 2020 who recorded higher prevalence of malaria among non-formally educated participants (32.8%). The incidence of typhoid in this study is not in consonance with Okolo *et al*., 2023 who reported more infection of typhoid fever among participants with a secondary level of qualification compared to other educational levels and this result also contradicts the work of Haruna *et al*., (2020) who recorded a high prevalence of typhoid among primary school level 21(9.7%). Furthermore, the prevalence of typhoid in this study with regard to residential area is in line with Okolo *et al*., 2023 who showed that participants from rural area 16(69.6%) has the highest prevalence of typhoid fever than those from urban area 7(30.4%). This also agreed with the report of Haruna *et al*.**,** 2020 who had a high prevalence of the typhoid infection among participants from rural areas (18.8%) than those from urban areas (6.3%).

The co-infection of malaria and typhoid fever prevalence obtained in this study was 50(45.5%). This is higher than the 4.5% obtained from Abuja, Nigeria (Sale *et al.*, 2019) but lower than the 36.3% and 56% that have been reported in Ebonyi (Andefiki *et al,* 2017) and Wukari (Odikanmoro *et al.,* 2017) respectively. Females 33(60.0%) had higher co-infection rate than males 27(49.1%). On the contrary, a co-infection prevalence rate of males 10(5.0%) and females 8(80.0%) were reported in Ekwulumili by Ongido *et al.,* 2014. The co-infection rate in the present study is not in agreement with what was obtained by Sale *et al*., 2020 who revealed that 51.1% of those co-infected were males while 48.9% were females. On the age group, 31 – 45 years had the highest co-infection rate 14(70.0%) and 61–75 years had the least co-infection rate of 4 (44.4%). This is not in line with the work of Ongido *et al*., 2014, who had the age group of 1–10 years with the highest co-infection rate, 1(11.0%) and 51 – 60 years as the least, 1(2.78%).

According to education level, non-formally educated participants had the highest co-infection incidence of 30(78.9%). This is closely similar to Haruna *et al*., 2020 who recorded a high prevalence among primary school level (3.2%) but contradicts Okolo *et al*., 2023 who revealed malaria-typhoid co-infection was not associated with educational status. This might be due to lack of proper knowledge about the mode of transmission and control of the disease. In terms of residential area, rural dwellers had the highest co-infection prevalence of 48(58.5%), this is in line with Okolo *et al*., 2023 and Haruna *et al*., 2020, who both reported high prevalence of the diseases among rural communities. This is because they do not have good access to clear portable water, poor access or adherence to effective control measures of malaria and unhygienic environmental practices. Malaria and enteric fever has been considered mainly, a disease of afflicting persons with low economic status where individuals with little daily earnings are at greater risk than their higher income earning counterparts. This study confirms the above statement as patients with low daily earnings showed higher prevalence of malaria 55(72.4%), typhoid 55(72.4%) and co-infection 47(61.8%).

CONCLUSION

Despite the fact that these two infections are co-endemic in Nigeria, the findings from this study show higher prevalence rates of malaria 67(60.9%) and typhoid fever 74(67.3%), the co-infection prevalence rate 60 (54.5%) was equally high. Socio-demographic factors have been found to influence the prevalence of malaria and enteric fevers like typhoid and paratyphoid as well as their co-infection, where it mainly affect children and young adults, females, non-educated, rural dwellers and low income earn participants. It is recommended that performing separate tests with the definitive diagnostic methods for malaria and typhoid fever on an individual presenting with fever to ascertain true co-infection, to be followed by appropriate treatment, should remain the best option if irrational use of antimalarials and antibiotics, emergence of drug resistance, unnecessary cost and exposure of patients to unnecessary side effects is to be avoided.

REFERENCES

- Ajibola, O., Mshelia, M. B., Gulumbe, B. H. and Eze, A. A. (2018). Typhoid Fever Diagnosis in endemic Countries: A Clog in the Wheel of Progress. *Medicina* (Kaunas, Lithuania), *54* (2), 1-12.
- Akinade, S. F., Shittu, O. B., Ojo, D. A. and Olufemi, F. O. (2015). Molecular identification of *Salmonella enterica serovar typhi* from Stool Culture of Widal test positive patients in selected Hospitals in Abakaliki, Nigeria. *International Journal of Scientific and Engineering Research*, *6(*8), 1053-1066.
- Andefiki, U., Ibrahim, A. and Ushie, E. F. (2017). Prevalence of Malaria and Typhoid Fever Co-infection and the Haematological Profile of patients attending Hospitals in Wukari Taraba State, Nigeria. *Journal of Bioscience*, *3*(6), 79-86.
- Birhanie, M., Tessema, B., Ferede, G., Endris, M. and Enawgaw, B. (2014). Malaria, Typhoid Fever, and their Coinfection among Febrile patients at a Rural Health Centre in Northwest Ethiopia: A Cross-Sectional Study Hindawi Publishing Corporation Advances in Medicine Volume 2014, Article ID 531074, 8 pages http://dx.doi.org/10.1155/2014/53107
- Cheesbrough, M. (2009). District Laboratory practice in tropical Countries. Part 1. (2nd ed.). New York: Cambridge University Press.
- Crump, J. A. and Kirk, M. D. (2015). Estimating the Burden of febrile Illness. *PLoS Neglected Tropical Diseases*, *9*(12).
- Deksissa, T. and Gebremedhin, E. Z. (2019). A cross-sectional study of enteric fever among febrile patients at Ambo hospital: prevalence, risk factors, comparison of Widal test and stool culture and antimicrobials susceptibility pattern of isolates. BMC Infectious Diseases, *19* (288), 1–12.
- Gay. F., Traore, B., Zananoni, J., Danis, M. and Gentilini, M. (1996). Direct Acridine Orange Fluorescence Examination of Blood Slides compared to current Techniques for Malaria Diagnosis. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 90,* 516-518.
- Haruna, I. M., Idris, M. M., Hussaini, A. S. (2020). Malaria and Typhoid Fever: Prevalence, Co-infection and socio-demographic determinant among pregnant Women attending antenatal care at a primary Health care Facility in Central Nigeria. *International Journal of Pathogen Research*, *5*(4), 17-24.
- Igbeneghu, C., Olisekodiaka, M. J. and Onuegbu, J. A. (2009). Malaria and Typhoid Fever among Adult patients presenting with Fever in Ibadan,

Southwest Nigeria. *International Journal of Tropical Medicine*, *4*(3), 112-115.

- Igharo, E. A., Osazuwa, F., Ajayi, S. A., Ebueku, A., Igbinigie, O. (2012). Dual Infection with Typhoid and Malaria in febrile patients in Ikare Akoko, Nigeria. *International Journal of Tropical Medicine*, 7(1), 49–52.
- Iheukwumere, I, Nwachukwu, C. N, and Kanu, M. A. (2013). Manifestations, mismanagement and diagnostic challenges of Malaria and Typhoid Fever. *Malar Chemoth Cont Elimination*, *2*(109), 38-41.
- Kargbo, M. S., Massaquoi, L. D., Samura, S. K., Meng, X. and Zou, F. (2014). The relative prevalence of Typhoid and Malaria in febrile Patients in Freetown, Sierra Leone. *Open Journal of Preventive Medicine*, *4*, 338-346.
- Mehta, A., Sharma, D. and Prakash, S. (2017). Comparative Evaluation of diagnostic performance of Blood culture, Lateral flow immunoassay, Tube Widal and Slide Widal Test in diagnosis of Enteric fever using a Composite Reference Standard. *Journal of Medicine and Clinical Research*, *5*(9), 27963-27971.
- Nas, F., Ali, M. and Yahaya, A. (2017). Malaria and Typhoid Fever Co-Infection among febrile patients. *Bayero Journal of Pure and Applied Sciences*, *10* (2). 122–125.
- Odikamnoro, O. O., Ikeh, I. M., Okoh, F. N., Ebiriekwe, S. C., Nnadozie, I. A., and Nkwuda, J. O. (2017). Incidence Of Malaria/Typhoid Co-Infection among Adult Population In Unwana Community, Afikpo North Local Government Area, Ebonyi State, South Eastern Nigeria. *African Journal of Infectious Disease, 12*(1), 33-38.
- Okolo, M., Adeshina, K., Omatola, C., Mudi, I. and Ugbane, E. (2023). Prevalence of Malaria and Typhoid Fever Co-infection among pregnant Women attending antenatal Clinic in Anyigba, Kogi State, Nigeria. Microbes and Infectious Diseases, *4*(2), 671-680. https://doi.org/10.21608/MID.2022.161413.1380
- Okore, O., Ubiaru, P. C., Nwadwugoru, U. G. (2015). Prevalence of Malaria and Typhoid Fever Co-infection: Knowledge, Attitude and Management practices among Residents of Aba, Abia State, Nigeria. *American Journal of Public Health Research*, 3(4), 162-166.
- Olepoenia, L. A. and King, A. L. (2000). Widal agglutination test-100 years later still plagued by controversy. *Postgraduate Medical Journal, 76*, 80-84.
- Ongido, A. E., Ifead. C. P., Umeanaete, P. V.,Iirikannu, K. C., and Aribodor, D. N., Ezeanya. L. C., and Obiechina, I. O. (2014). Co-infection of Malaria and Typoid Fever in Ekwulumili Community, Anambra State, Southern State Nigeria*, New York Science Journal 7*(7), 18-27.
- Orok, D. A., Usang, A. I., Ikpan, O. O., Duke, E. E., Eyo, E. E., Edadi, U. E., Ati, B. U. and Udida, J. A. (2016). Prevalence of Malaria and Typhoid Fever Co-infection among Febrile Patients attending College of Health Technology medical Centre in Calabar, Cross River State, Nigeria*. International Journal of Current Microbiology and Applied Sciences*, *5*(4), 825- 835.
- Sale, M., Ja'afaru, M.I.and Adedeji, B. A. (2019). Distribution of Antibiotic resistant and Biofilms producing *Salmonella enterica* Serovar Typhi in Michika and Mubi L.G.A. of Adamawa State. Nigerian. *Journal of Microbiology, 33*(2), 475-4765.
- Sale, M., Pukuma, M. S., Adedeji, B. A. M. and Shehu, A. (2020). Prevalence of Typhoid and Malaria Co-infection among patients attending a public Hospital in Yola, Nigeria. *International Journal of Mosquito Research, 7*(3), 42-47.
- Sundufu, A. J., James, M. S. and Foday, I. K. (2012). Role of Co-infection with Malaria Parasites and Salmonella Typhoid in Bo City. *Southern Sierra Leone Public Health Research*, *2(*6), 204–207.
- Tadesse, H. and Tadesse, K. (2013). The Aetiology of febrile Illnesses among febrile patients attending Felegeselam Health Centre, Northwest Ethiopia. *American Journal of Biomedical and Life Sciences*, *1*(3), 58-63.
- Ukaegbu, C. O., Nnachi, A. U., Mawak, J. D. and Igwe, C. C. (2014). Incidence of concurrent Malaria and Typhoid fever Infections in febrile patients in Jos, Plateau State Nigeria. *International Journal of Scientific and Technology Research, 3*(4), 159-160.
- USAID. (2017). Funding of Universal Health Coverture and Family Planning: A Multi-Regional Landscape study and Analysis of selected West African Countries.
- WHO (2020). World malaria report 2020: 20 years of global progress and challenges. *World Health Organization*.
- World Health Organization. (2018). WHO Typhoid. Available at: https://www.who.int/mediacentre/factsheets/typhoid/en/. Retrieved March 23, 2019.