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INCIDENCE OF MALARIA/TYPHOID CO-INFECTION AMONG ADULT POPULATION IN UNWANA COMMUNITY, AFIKPO NORTH LOCAL GOVERNMENT AREA, EBONYI STATE, SOUTHEASTERN NIGERIA

O.O. Odikamnoro[1*], I.M. Ikeh[1], F.N. Okoh[2], S.C. Ebiriekwe[3], I.A. Nnadozie[4], J.O. Nkwuda[5], G.C. Asobie[6]

[1]Department of Biological Sciences, Faculty of Science, Ebonyi State University, P.M.B 053, Abakaliki, Nigeria. [2]Department of Biological Sciences, College of Science, Evangel University, Akaeze, Ebonyi State, Nigeria. [3]Raw Materials Research and Development Council, Abuja, Nigeria. [4]Department of Biological Sciences, Federal University of Technology, Owerri. Nigeria. [5]Parasitology Research Unit, Federal University Ndufu-Alike, Ikwo, Nigeria. [6]Department of Pharmacology, Faculty of Health Sciences, Benue State University, Makurdi.

***Corresponding Author Email:** oliverodikamnoro@gmail.com

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Abstract

Background: Malaria and typhoid fever are two leading infections of poverty with serious health and socioeconomic impacts, and due to their geographical overlap, co-infections are very common. Their mimicking symptomatology often present with gross misdiagnosis and mistreatment. This study was carried out to determine the incidence of malaria and typhoid co-infections among adult population in Unwana Community, Afikpo-North Local Government Area of Ebonyi State.
Materials and Methods: Three hundred and fifty (350) individuals were examined, their blood samples subjected to microscopic examination and widal agglutination tests, for identification of Plasmodium parasites and antibodies to *Salmonella enterica* serovar *typhi* respectively. Questionnaire was administered to obtain information on malaria/typhoid management practices.
Results: Out of the 350 blood samples analysed, 190 (54.2%) were positive for malaria, 173 (49.4%) were positive for *Salmonella enterica* serovar *typhi*, while 127(36.2%) were positive for both typhoid and malaria. However, prevalence of malaria parasite was statistically significant in relation to sex ($p<0.05$), as males had 50% prevalence and females, 58%. For *Salmonella enterica* serovar *typhi*, the prevalence was not statistically significant in relation to sex ($p>0.05$); while males had 57% prevalence for *Salmonella enteric serovar typhi*, females had 42%. Sex was statistically significant ($p<0.05$) concerning prevalence rate of malaria/typhoid co-infection; males had 35% co-infection rate while females had 37%. The management practices studied revealed that over 80% of the respondents preferred environmental sanitation as the best prevention/control method. In the case of treatment, buying medicine from pharmacy shops was common (48%). This was followed by the use of herbal remedies (31%), while appreciable number adopted self-treatment method (18%).
Conclusion: Both malaria and typhoid were prevalent among the studied population with high rate of co-infection. Co-infection was higher in females than males and use of herbal medicine for treatment was common. Efforts should be made to improve on the living conditions of the people of Unwana and also, there should be public enlightenment on the preventive and control measures of the two diseases. Since both diseases have similar symptomatology, treatment should be based on adequate laboratory diagnosis. Also, personal hygiene is hereby encouraged among the populace.

Keywords: Malaria, typhoid, *Plasmodium*, *Salmonella*, coinfection

Introduction

Malaria is a life threatening disease caused by five species of protozoan parasite of the genus *Plasmodium* (*P. falciparum, P. vivax, P. malariae, P. ovale and P. knowlesi*) that is transmitted to humans through the bites of an infected

female anopheles mosquito (Ukaegbu *et al.,* 2014; Mbah *et al.,* 2015; Iwuafor *et al.,* 2016). Nearly all human deaths by malaria are caused by *P. falciparum*, mainly in sub-Saharan Africa. Globally, an estimated 3.3 billion people in 97 countries and territories are at risk of being infected with malaria and developing disease and 1.2 billion are at high risk (WHO, 2011; Iwuafor *et al.,* 2016). It is estimated that 198 million cases of malaria occurred globally in 2013 and the disease led to 584,000 deaths representing a decrease in malaria case incidence and mortality rates of 30% and 47% since 2000, respectively (WHO, 2013 and 2014). It is considered a disease of poverty and duly recognized as a public health problem with overwhelming medical, social and economic implications (Isah *et al.,* 2011). Malaria exacts a heavy burden on the poorest and most vulnerable communities of which the people of Unwana community Afikpo is not an exception.

Within endemic countries, the poorest and most marginalized communities are the most severely affected, having the highest risks associated with malaria, and the least access to effective services for prevention, diagnosis and treatment (World Bank, 2014).

On the other hands, typhoid fever, also known simply as "typhoid" is a symptomatic bacterial infection due to *Salmonella* typhi equally called *Salmonella enterica* serotype Typhi (Modebe *et al.,* 2014; Wain *et al.,* 2015). It is acquired by the ingestion of food and/or water contaminated with the faeces of an infected person, which contain the bacterium, *Salmonella enteric* serovar *typhi*; humans are the only infected (Ukaegbu *et al.,* 2014). Risk factors include poverty as a result of poor sanitation and poor hygiene (Wain *et al.,* 2015). In the year 2000 and 2010, an estimated 21.7 million and 13.5 million typhoid fever illnesses were recorded. Between years 2000 and 2013, it resulted in estimated 217,000 and 161,000 deaths respectively (Crump *et al.,* 2010; Buckle *et al.,* 2010). Infants, children, and adolescents in south-central and Southeast Asia experience the greatest burden of illness (Crump *et al.,* 2004). Nonetheless, outbreaks of typhoid fever are frequently reported from sub-Saharan Africa and countries in Southeast Asia (Muyembe *et al*, 2009 and Baddam *et al*, 2012).

Due to the geographical overlap of both infections, co-infections are very common. However, the precise incidence of the concurrent malaria and typhoid fever in most geographical areas is largely uncertain, as both share social circumstances which are imperative to their transmission; individuals in areas endemic for both diseases are at substantial risk of contracting both these diseases, either concurrently or an acute infection superimposed on a chronic one (Keong *et al.,* 2006). While high prevalence of malaria is an established fact, it is only within the last decade that an unusually high number of illnesses have been diagnosed as malaria co-existing with typhoid fever (Ammah *et al.,* 1999; Kanjilal *et al.,* 2006; Ohanu *et al.,* 2003; Samal *et al.,* 1991; Sur *et al.,* 2006). Malaria and typhoid fever often present with mimicking symptoms especially in the early stages of typhoid fever (Ammah *et al.,* 1999; Ohanu *et al.,* 2003). The situation often presents a diagnostic problem and in some cases could lead to diagnostic confusion. As a result of this, the importance of definitive laboratory-based diagnosis cannot be overstated, before an individual is said to have concurrent malaria and typhoid fever, the presence of *Plasmodium* species and *Salmonella enteric* sub-sp *enterica* serotype *typhi* must be demonstrated in the patient's laboratory specimens (Uneke 2008). Such clinical study has not been done in Ebonyi State. Hence, this paper presents a study carried out to determine the prevalence of malaria, typhoid and their confection in Unwana community Afikpo, Ebonyi State.

Materials and Methods

Study Area

The study area is Afikpo, the second largest city in Ebonyi State, The area is situated on latitude 5^0.53N and longitude 7^0.56E. The average temperature in the area is highest in the month of March (84.0^0F, 29.0^0 C) and lowest in the month of August with 78.1^0F (25.6^{0c}). Annual rainfall ranges from 1600m to over 2000m and the driest month having less than 29m of rainfall. The population is estimated at 156611 (NPC, 2006).

Ethical Considerations

Prior to the study, ethical approval was obtained from Research and Ethics Committee of the Ebonyi State University, Abakaliki, while permission was obtained from the village council chiefs. Consent was sought and obtained from participants or their relations and only those who gave their consents were enrolled into this study. Information or results obtained from the study was treated with utmost confidentiality and used for the purpose of the research only.

Study Population/Sample Collection

Blood samples were collected from three hundred and fifty volunteers from Unwana community, including 164 males and 186 females of ages between zero to sixty (0-60) years and above and processed in the Department of Biological Science Laboratory, Faculty of Science, Ebonyi State University, Abakaliki, Ebonyi State.

Study Design/Laboratory Protocol

This was a prospective observational study. Structured questionnaire were administered to the study population who were volunteers from Unwana community, to pool their perceptions of malaria, typhoid and malaria/typhoid infection, how they manage the attack and control method preferred. Blood samples were collected and screened for malaria microscopically using thick and thin films stained with Giemsa and Leishman's stain methods (Ochei and Kolhatkar, 2010). Also, the blood samples were screened for typhoid fever using antibody titre of the sera against Salmonella H (flagella)- and O-(Somatic) antigens by widal agglutination test on plasma component of the blood samples (Ochei and Kolhatkar, 2010).

Statistical analysis: Data were analyzed using statistical package for social sciences (SPSS) version 19.0 (Chicago, USA). Chi-square (χ^2) was used to determine if the relationships between the Malaria parasite infection and *Salmonella serovar enterica typhi* were actually significant.

Results

Blood samples were collected from a total of 350 individuals. These blood samples were examined for the presence of malaria, typhoid and malaria/typhoid co-infection in relation to age/Sex among people in Afikpo and the results are presented below.

Table 1 shows that there is prevalence of malaria parasite in Unwana community and among all the age groups in the sampled population. A total population of 350 individuals was tested for malaria parasite and 190 were positive. The total percentage prevalence ranged from 33.3% to 72.4% across the ages. The highest and lowest percentage prevalence were recorded in age groups 60> and 50-59 respectively. The table equally shows that in terms of sex, females had a total prevalence of 108 (58%) and their highest number (30) of infected patients recorded within ages 20-29 (P>0.05). Males had total prevalence of 82 (50%), their highest (20) recorded within ages 10-19 (P<0.05).

Table 2 reveals that typhoid fever was prevalent in Unwana community Afipko among all the age groups. Out of 350 serum samples tested, 173(49.4) were positive for typhoid fever. The total percentage prevalence ranged from 13.1% to 75.6% across the age groups. The highest and lowest percentage prevalence were recorded in age groups 40-49 and 0-9 respectively. The table also shows that in terms of sex, the total prevalence for females was 79 (4.42%) and a highest number (23) of infected patients recorded among ages 10-19 (P>0.05). Males had a total prevalence of 94 (57.3%), the highest number (20) of infected patients recorded among ages 10-19 (P>0.05).

Table 1: Prevalence of malaria parasite in relation to age/sex among sampled population in Unwana, Afikpo.

Age (years)	Total No. Examined	Male		Female		Total Prevalence (%)
		No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	
0-9	38	18	5(27.7)	20	8(40.0)	13(34.2)
10-19	68	33	20(60.6)	35	24(68.5)	44(64.7)
20-29	85	41	19(46.3)	44	30(68.1)	49(57.6)
30-39	56	27	18(66.6)	29	15(51.7)	33(58.9)
40-49	41	19	8(42.1)	22	11(50.0)	19(46.3)
50-59	33	14	5(35.7)	19	6(31.5)	11(33.3)
≥60	29	12	7(58.3)	17	14(82.3)	21(72.4)
Total	**350**	**164**	**82(50.0)**	**186**	**108(58.1)**	**190(54.3)**

Table 2: Prevalence of Typhoid infection in relation to age/sex among sampled population in Unwana, Afikpo.

Age (years)	Total No. Examined	Male		Female		Total Prevalence (%)
		No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	
0-9	38	18	3(16.7)	20	2(10.0)	5(13.1)
10-19	68	33	20(60.6)	35	23(65.7)	43(63.2)
20-29	85	41	19(46.3)	44	12(27.2)	31(36.4)
30-39	56	27	15(55.6)	29	11(37.9)	26(46.4)
40-49	41	19	18(94.7)	22	13(59.0)	31(75.6)
50-59	33	14	9(64.2)	19	8(42.1)	17(51.5)
≥60	29	12	10(83.3)	17	10(58.8)	20(68.9)
Total	**350**	**164**	**94(57.3)**	**186**	**79(42.4)**	**173(49.4)**

Table 3 shows that there is also prevalence of malaria/typhoid co-infection among the sampled population of Unwana community Afikpo. Out of 350 individuals tested for Malaria/Typhoid co-infection, 127(36.3%) were positive. The total percentage prevalence ranged from 23.7% to 44.7% across the age groups. The highest and lowest percentage prevalence were recorded within ages 20-29 and 0-9 respectively. In terms of sex, females had total prevalence of 69(37.1%) and patients within age groups 20-29 ($P<0.05$) had the highest number (38) of infected individuals. Males had a total prevalence of 58(35.4%) and the highest number (20) of infected patients recorded among age 20-29 ($P<0.05$)

Table 3: Prevalence of Malaria parasite and Typhoid co-infection in relation to age/sex among sampled in Unwana, Afikpo.

Age (years)	Total No. Examined	Male		Female		Total Prevalence (%)
		No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	
0-9	38	18	4(22.2)	20	5(25.0)	9(23.7)
10-19	68	33	10(30.3)	35	12(34.3)	22(32.4)
20-29	85	41	20(48.8)	44	18(40.9)	38(44.7)
30-39	56	27	7(25.9)	29	9(31.0)	16(28.6)
40-49	41	19	9(47.4)	22	8(36.4)	17(41.5)
50-59	33	14	3(21.4)	19	11(57.9)	14(42.4)
≥60	29	12	5(41.7)	17	6(35.2)	11(37.9)
Total	**350**	**164**	**58(35.4)**	**186**	**69(37.1)**	**127(36.3)**

Discussion

The findings reveal that a total percentage prevalence of 54.2% for malaria parasite was recorded among the sampled population of Unwana community. This is quite high. It shows that mosquitoes' breeding, inoculation and transmission rate is very high, hence the study area is endemic for malaria. This high prevalence of malaria parasitaemia could be attributed to environmental factors such as altitude and rainfall and thick vegetations, which promote the intensity of mosquitoes breeding and transmission in Unwana, Afikpo. Also, the case of Unwana Afikpo is worsened due to their poor knowledge of methods for prevention/control of mosquitoes bites, hence malaria. Record from this study noted that 123 out of 350 sampled individuals believed that environmental sanitation is the best method for prevention/control of malaria. Little did they know that prevention of mosquito human contact (*'personal protection')* by the use of barriers (Insecticide Treated Nets and materials, repellent, wearing protective clothing) to deter mosquitoes from biting them could have helped the situation better, especially as majority of the population engaged in outdoor activities for their living. Study revealed that out of the 350 sampled populations, 61 and 72 were farmers and fishermen respectively. This shows that the people of Unwana Afikpo are mainly farmers by occupation and most of the time leave their whole body bare when they are cultivating in the farm and could stay as late in the farm as when determined female mosquitoes seek blood meal. This is in line with WHO (2014), which stressed that malaria control intervention by use of ITN reduces transmission by the mosquito vector from humans to mosquitoes and then back to humans. *Plasmodium falciparum* was the only malaria parasite detected in the sampled populations. It agrees with the related study carried out in rural community in Lagos where only *Plasmodium falciparum* infection were reported (Ademowo *et al*., 1995)

However, this does not correspond with low numbers/percentages of respondent knowledge on common symptoms/signs of malaria recorded. It was noted that out of 350 individuals sampled, 76 (22%) responded positively for fever, 87 (25%) for chills and 41 (12%) for night sweat. Also 55% (15%) responded positively for headache and 57 (16%) for fatigue. This means that out of 190 individuals who tested positive for malaria parasite, only 87 (less than half) had the symptoms/signs (fever, chill, night sweat, headache and fatigue) of parasite presence in their blood before the test and actual parasite identifications. One hundred and three (103) did not experience any change in their body function that indicated a symptom/sign of malaria, even though their blood samples tested positive for malaria parasites. This asymptomatic parasitaemia could be attributed to the level of immunity they have developed because of constant mosquito bites and frequent attack of malaria infection. Hence, they carry malaria parasite in their blood without showing any symptoms. This is in line with the observations of most studies in endemic settings (Booth et *al*., 2001; Deressa *et al*., 2003; Dunyo *et al*., 2000; Garhard, 2005; Okoh *et al.*, 2014). These symptoms/signs were confirmed as actual indication of malaria parasite presence, when in a related study in endemic area, the sampled children who had increase in number of these symptoms/signs were protected from mosquitoes bites with lambdacyhalothrin treated household items, after one month the symptoms decreased significantly (Okoh *et a*l., 2014).

The high percentage prevalence (49.4%) of *Salmonella typhi* infections recorded in this study, could be due to haemolytic anaemia and malaria parasite-specific factors which increases the susceptibility of the patients to non-typhoidal salmonella serotypes (NTS) as reported by (Mbuh *et al.*, 2003). Here it was found out that an increased risk for developing systemic NTS infection during malaria is caused by haemolytic anaemia, which leads to reduced macrophage microbicidal

activity. Unlike the diagnosis of malaria, typhoid fever presents a greater diagnostic challenge. A single widal test has even been pointed out to be of diagnostic value in the early stage of disease and thus help in reducing morbidity and mortality from typhoid, (Pang and Puthucheary, 1983; Parry *et al.,* 1999). The interpretation of widal test results, when diagnosing concurrent malaria and typhoid fever must therefore be done with a lot of caution.

The questionnaire result showed that most people (99%) had knowledge about malaria, while an appreciable number (55%) knew about typhoid fever. However, knowing about malaria is not enough; it should be seen as a foundation through which a whole range of issues about malaria should be understood, for example, malaria transmission, signs and symptoms, prevention and treatment (Khumbulani, *et al.,* 2009). The high prevalence of typhoid fever could be attributed to the source of drinking water (streams/rivers) in the area as most inhabitants did not boil their drinking water. Also, indiscriminate defaecation in bushes around water drinking water sources was a common practice; this could have contributed to the high burden of typhoid fever recorded in this study. On the promptness of seeking treatment, 24% of respondents in this study stated that they would seek treatment within 24 hours of onset of malaria/typhoid symptoms. However, as encouraging as it may seem, this number still fell below the World Health Organization (WHO) recommendation, which stipulates that "at least 60% of those suffering malaria should seek treatment within 24 hours of the onset of symptoms" (WHO 2000). Thirty-five percent (35%) reportedly delayed for 2-3 days before seeking treatment; 19% delayed for 4-6 days, 13% for 7 days or more, while 9% did not know. This study also showed that 48% of the respondent opted for buying medicine from pharmacy as their first seeking treatment option, followed by 31% for herbal medicine, 18% adopted self-treatment; only 3% thought of going to hospital. Delay in treatment and treatment option could contribute to persistence and continued transmission of the infections.

Conclusion

In view of this study, malaria and typhoid fever were prevalent in Unwana, Afikpo and still remain diseases of major public health importance. Comparably, both malaria parasitaemia and its co-infection with typhoid was more prevalent in females than in males of Unwana Afikpo. Typhoid fever was found to be more prevalent in males than in females. Since both are diseases of poverty, efforts should be made to improve on the living conditions of the people of Unwana. Also, there should be public enlightenment of the preventive and control measures of the diseases. Both diseases have similar symptomatology; therefore, treatment should be based on adequate laboratory diagnosis. Also, personal hygiene is hereby encouraged among the populace.

Conflict of Interest: No conflict of interest of any kind exists for this study.

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