



Malaria Co – Infection with Urinary Schistosomiasis, Typhoid Fever, Hepatitis B Virus, and Human Immunodeficiency (HIV) Virus among Students in Three Local Government Areas of Ekiti State, South Western Nigeria

C. A. Ologunde ^a, F. T. Akinruli ^{a*} and T. O. Layo-Akingbade ^a

^aDepartment of Science Technology, Federal Polytechnic, P.M.B. 5351, Ado-Ekiti, Ekiti State, Nigeria.

Authors' contributions

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

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ABSTRACT

Introduction: Malaria, Typhoid fever, urinary schistosomiasis, AIDS and hepatitis B virus disease are major public health problems in the tropical and subtropical countries; they exert a huge burden of morbidity, mortality and economic loss on the populace.

Aims: The study investigates the prevalence of co-infection of malaria, typhoid fever, urinary schistosomiasis, hepatitis B virus and HIV virus among 306 students between the ages of 10- 21 years in three local government areas of Ekiti – state Nigeria.

Methodology: Blood samples were randomly collected for the examination of malaria parasites, typhoid fever, hepatitis B virus and HIV virus while urine examination was done for urinary schistosomiasis by random sampling and survey for a period one week.

Results: The results show that the overall prevalence of malaria, typhoid fever, urinary schistosomiasis and hepatitis B virus were 42.2%, 2.9%, 2.9% and 2.9% respectively. The female students had the highest prevalence of single infection with malaria fever having the highest figure

*Corresponding author: E-mail: toyinkinruli@gmail.com;

(42.2%). Malaria and Urinary schistosomiasis had the highest prevalence of double infection of 2.3 %, while schistosomiasis and hepatitis B had the lowest prevalence of 0.3%. Also, male students had the highest prevalence of double and triple infections. The co-infection rate of malaria, urinary Schistosomiasis and hepatitis B was 0.3% and this occurred in male between the ages of 19-21 years, none of the students tested positive for HIV virus and therefore no students was found in the quaternaries.

Conclusion: Co-infections is prevalent in this study area, therefore there should be integrated control approach directed against these diseases.

Keywords: Co-infection; HIV; Hepatitis B; Malaria; typhoid fever and Urinary schistosomiasis.

1. INTRODUCTION

Malaria, typhoid fever, urinary schistosomiasis, AIDS and hepatitis B virus diseases are major public health problems in the tropical and subtropical countries. They are caused by different organisms namely: *Plasmodium falciparum*, *Salmonella typhi*, *Shistosoma hematobium*, HIV virus and hepatitis B virus respectively [1]. It is possible for an individual to be infected with more than one or all these diseases at the same time, This phenomenon is known as co- infection [2]. The occurrence of co-infection depends on the overall prevalence of each disease and the degree of association between different infections; co-infection is of particular human health importance because pathogen species can interact within the host [3].

Across the continent, a number of helminth species share the same spatial extents as *P. falciparum* which is the causative agent of malaria fever, an example of such species is *Schistosoma haematobium* that causes schistosomiasis. It is possible for the helminth infection to affect the outcome of malaria or its course leading to co-infection [4]. Malaria is a potentially life-threatening parasitic disease which poses an enormous public health burden as it affects 1 billion people each year; out of which 1–3 million die [5,6].

Typhoid fever is a symptomatic bacterial infection due to *Salmonella typhi* [7]. Malaria and typhoid fever are ailments of community health concern in the sub-Sahara area of the biosphere with similar clinical symptoms and fever being the foremost medical presentation [8]. An estimated 17 million cases of typhoid are reported worldwide each year, resulting in 0.6 million deaths [9]. It is acquired through the consumption of contaminated food or water [6], there is possibility for typhoid fever to share social circumstances with other ailments like hepatitis B virus infection, malaria and AIDS.

Hepatitis B virus is an infectious disease caused by the hepatitis B virus (HBV) which affects the liver, the virus is transmitted by exposure to infectious blood or body fluids [10,11]. It is a global public health concern, with the prevalence ranging from 5–10%, and it is ranked the 15th cause of death in the world [12]. Approximately 15–25% of HBV infected people die due to liver cirrhosis, liver failure, or hepatocellular carcinoma [13].

AIDS is caused by human immunodeficiency virus (HIV), AIDS progression and transmission is strongly associated with blood viral burden [14]. Malaria is an important cause of disease in HIV- infected adults whenever the two infections coexist; it induces changes in viral load resulting from series of immunological mechanisms [15,16]. During HIV infection, progressive failure of the immune system allows life-threatening opportunistic infections [17], the body becomes progressively more susceptible to opportunistic infections like malaria, typhoid fever and hepatitis B [18]. These co-infectious diseases exert a huge burden of morbidity, mortality and economic loss which intensifies the under development of the population [19], due to these reasons, it is imperative to investigate the extent of co-infection of malaria with urinary schistosomiasis, typhoid fever, hepatitis B virus infection and HIV infection within the 3 local government areas in Ekiti state, Nigeria.

2. MATERIALS AND METHODS

2.1 The Study Area and Population

The study was conducted in March, 2019, and was carried out among 306 students by random selection from three local governments in Ekiti State, Nigeria; these include Gbonyin, Ifelodun/Irepodun and Ado-Ekiti local government. The sample size was determined by the ages of the students between 10-21 years, and by gender (male and female).

2.2 Diagnosis of Malaria

The diagnosis of malaria fever was carried out by using SD BIOLINE malaria Ag p.f test kit containing a membrane strip pre-coated with mouse monoclonal antibodies specific to HRP-H of *P. falciparum* [20]. The area to be pricked was cleaned with an alcohol swab, the end of the fingertip was squeezed and pierced with a sterilized lancet, the blood was collected in a heparinized capillary tube. The blood in the heparinized tube was transferred into the round sample well and 4 drops of assay diluents provided with the kit were dropped into the squared assay diluent well and allowed to run for a minimum of 15 before reading, the test was observed for the presence of color bands.

2.3 Diagnosis of Typhoid Fever

The diagnosis was carried out by using Solid Rapid diagnostic test kit. This test depends on the ability of the antibody in the patient serum to agglutinate the stained bacterial antigens. The area to be pricked was cleaned with an alcohol swab, the end of the fingertip was squeezed and pierced with a sterilized lancet, the blood was collected in a heparinized capillary tube, sealed on a sealant and labelled. The blood collected were allowed to clot to form a retract and centrifuged at 1500rpm for 5 minutes to get a clearer serum, a few drops of it was placed on the consecutive circle on the tile provided along with the kit. A drop of the antigen was added to the appropriate circle on the tile, mixed and spread to cover the entire test circle with a disposable micro pipette, this was gently and evenly rocked for 1 minute while examining for the presence of agglutination.

2.4 Diagnosis of Hepatitis B Virus

This was carried out based on the method used by Tesfa [12]. The area to be pricked was cleaned with an alcohol swab, then end of the fingertip was squeezed and pierced with a sterilized lancet. The blood was collected in a micro pipette and a drop of the blood sample was placed on the sample pad for it to be completely absorbed. A drop of blood diluents was added to it and allowed to run for 5 minutes. The test was observed for the presence of pink colored band in the test region.

2.5 Diagnosis of Urinary Schistosomiasis

This was carried out based on the method described by Moriyasu et al. [4]. Urine samples

were collected in sterilized sample bottles, they were centrifuged at 1500rpm for 15 minutes, the supernatant was decanted, 2-3 drops of the residue were placed on a clean glass slide and covered with a cover slip. The preparation was observed under the microscope by using $\times 10$ objective lens.

2.6 Statistical Analysis

Data obtained from this study were analyzed by descriptive statistical methods.

3. RESULTS AND DISCUSSION

A total of 306 students stratified by age and sex were recruited in this study, the age ranges were 10-12, 13-15, 16-18 and 19-21 (Table 1). The age range 13-15 had the highest frequency of occurrence (134) while the age range 19-21 had the least number (35).

The overall prevalence of malaria, typhoid fever, urinary schistosomiasis and hepatitis B virus disease were 42.2%, 2.9%, 2.9% and 2.9% respectively (Fig. 1). The female students have the highest prevalence of single infection with malaria fever having the highest prevalence, this could be due to poor knowledge of the methods of preventing mosquito bites, poor hygiene, low immunity of the students to fight against the pathogens and environmental factors such as the presence of breeding places for mosquitoes, bushy and dirty environments which can promote the intensity of mosquitoes breeding and transmission. This result corroborates the result of Afolabi et al. [18], where malaria fever had the highest prevalence of (77%) when compared to the two other disease agents (hepatitis B virus and HIV virus). The prevalence of urinary schistosomiasis (2.9%) could be as a result of lack of potable water where by majority of the populace depend on sources of water like stream and pond for drinking, swimming and other domestic activities [18]. Hepatitis B virus infection which has the same prevalence rate of (2.9%) with urinary schistosomiasis may occur as a result of exposure to infected blood or other body fluids. The prevalence of typhoid fever may be due to the consumption of contaminated food and water; majority of the students do not have access to potable water, some obtained their drinking water from streams, ponds and rivers in areas where indiscriminate urination was a common practice [6].

Table 1. Study population of 306 students stratified by age and sex from the three local governments in Ekiti state

Age	Total		Females		Males	
	No	(%)	No	(%)	No	(%)
10-12	88	28.8	61	20.0	27	8.8
13-15	134	43.8	74	24.2	60	19.6
16-18	49	16.0	28	9.2	21	6.9
19-21	35	11.4	25	8.2	10	3.3
Total	306		188		118	

Table 2. Prevalence of Triple infections stratified by age/ sex among the students

Variables Sex/ Age	MST		MSH		MTH	STH
	No.	(%)	No.	(%)	No.	No.
Male	118	0	1	(0.3)	0	0
Female	188	0	0		0	0
10- 12	88	0	0		0	0
13- 15	134	0	0		0	0
16-18	49	0	0		0	0
19- 21	35	0	1	(0.3)	0	0

MST= malaria/schistosomiasis/ typhoid,
 MSH = malaria/ schistosomiasis/hepatitis
 MTH = malaria/typhoid/hepatitis,
 STH= Schistosomiasis/typhoid/hepatitis

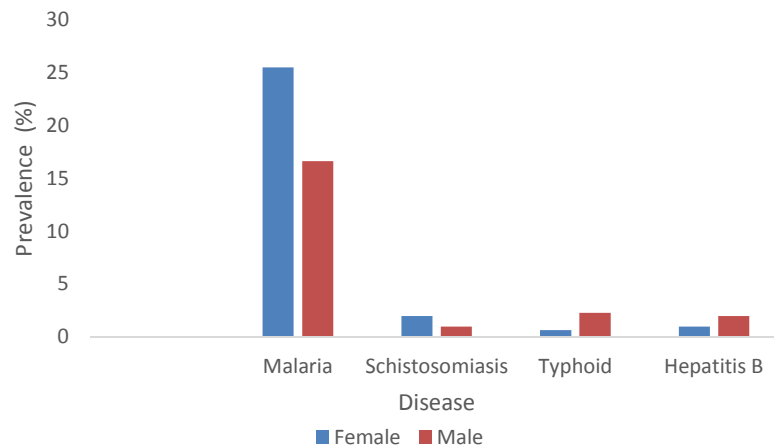


Fig. 1. The overall prevalence of the diseases stratified by sex

Male students have the highest prevalence of double infections of malaria and typhoid fever (0.98%) while the co-infection of schistosomiasis and hepatitis B infection (0.3%) has the least prevalence (Fig. 2A). This may be due to inadequate use of mosquito nets and lack of good personal hygiene. Female students have the highest prevalence of malaria and Schistosomiasis (1.31%), this could be attributed to poor hygiene, and daily exposures to water related activities most especially swimming. The male students has the highest prevalence of

double infections in this study, this result contradicts the work of Ojo *et al.* [2], where the female subjects had higher co-infection rates than the males.

The age group 13-15 has the highest prevalence of co-infection of malaria and urinary schistosomiasis (0.93%) (Fig. 2B). This age group is mainly adolescents who are usually engaged in water related activities including swimming. There is no co-infection of double infections in the age group 19-21. This group are

adults who have good knowledge about the use of mosquito nets and they are not frequently engage in swimming.

Male students have highest prevalence of co-infections of triple infections (Table 2). The co-infection rate of malaria, Schistosomiasis and

hepatitis B is 0.3%, this occurred in male students between the ages of 19-21 years. This could be attributed to poor hygiene, and daily exposures to water related activities most especially swimming. Secondly it could also be due to mosquito bites and lack of good personal hygiene of the students.

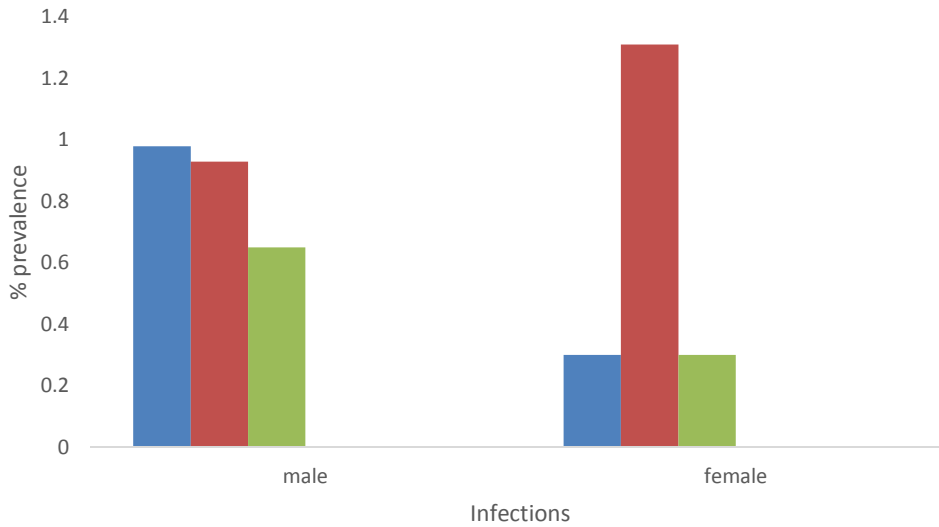
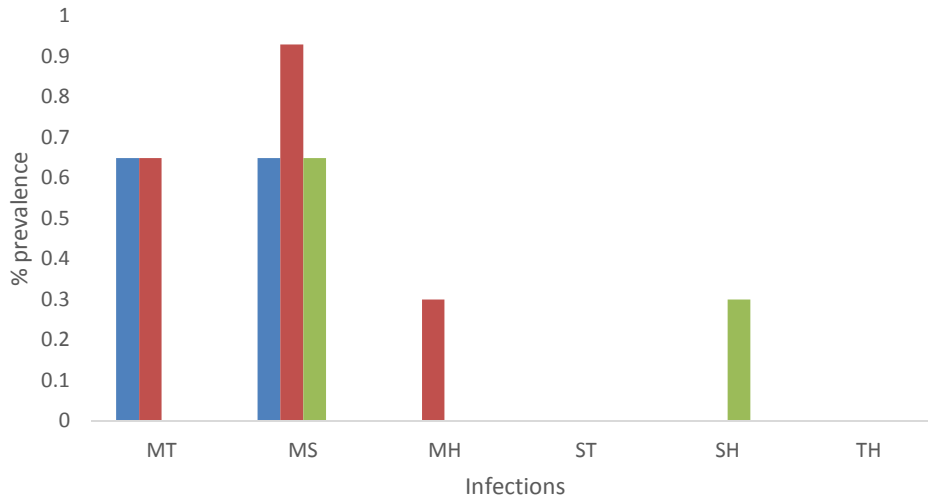


Fig. 2A. Prevalence of double infections stratified by sex among the students



MS - Malaria and schistosomiasis
 MT - Malaria and typhoid
 MH - Malaria and hepatitis B
 ST - Schistosomiasis and typhoid
 SH - Schistosomiasis and hepatitis B
 TH - Typhoid and hepatitis B

■ 10-12 ■ 13-15 ■ 16-18 ■ 19-21

Fig. 2B. Prevalence of double infection stratified by age among the students

Table 3. Prevalence of single and multiple infections

Variables	Prevalence	(%)
Single infection		
Malaria	129	(42.2)
Schistosomiasis	9	(2.9)
Hepatitis	9	(2.9)
Typhoid	9	(2.9)
HIV	0	
Double infection		
Malaria and schistosomiasis	7	(2.3)
Malaria and Typhoid fever	4	(1.3)
Malaria and hepatitis B	3	(1.3)
Schistosomiasis and Typhoid	0	
Schistosomiasis and hepatitis B	1	(0.3)
Typhoid and hepatitis B	0	
Triple infection		
Malaria, Schistosomiasis and typhoid fever	0	
Malaria, schistosomiasis and hepatitis B	1	(0.3)
Malaria, Typhoid fever and Hepatitis	0	
Schistosomiasis, Typhoid fever and hepatitis	0	
Quaternary		
Malaria, Schistosomiasis, Typhoid fever and hepatitis	0	
No of infection/child		
1 infection	156	(50.9)
2 infections	15	(4.9)
3 infections	1	(0.3)
4 infections	–	0

The summary of the prevalence of single and multiple infections is shown in Table 3, a total of (150) 50.9%, (15)4.9%, (1)0.3% of the students have single, double and triple infections respectively while none of the students was found in the quaternaries. There is co-infection in this study, the rate of co-infections could be due to factors such as poverty, poor hygiene, lack of aesthetic sense and lack of public health knowledge. This result in line with Olayinka *et al.* [21] who observed co-infections of SARS-CoV-2 with other infections in patients.

4. CONCLUSION

The prevalence of malaria, typhoid fever, urinary schistosomiasis and hepatitis B virus were 42.2%, 2.9%, 2.9% and 2.9%. Some of these diseases co-exist with others in the study, therefore there should be consistent sensitization programs on public health to enlighten the people about malaria, schistosomiasis, typhoid fever, hepatitis B and AIDS in order to completely minimize the spread of these diseases.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our

area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical approval of the study was obtained from the director of schools in the three local government areas in Ekiti State, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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