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Full Length Research Paper

Prevalence and socio-demographic factors associated with malaria infection among children under five years in Tanzania

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Malaria is one among four main infectious diseases leading in death for the under-five children in Africa. This study aim to determine prevalence of malaria and social demographic factors related with children under-five in Tanzania. The study used cross section data extracted from Tanzania demographic health survey collected from 2015 to 2016. A sample of 9,322 under five children with malaria rapid diagnostic test results was obtained from 10,899 households. Complimentary log-log model was used to determine factors associated with malaria among children under five years. The study reveals that malaria prevalence increases with increase in age, varies with place and zone of residence, being highest to the rural areas compared to urban. Complementary log-log model estimates has also indicated that Western zone was having a highest mean occurrence of children with malaria compared to all other zones whereas Zanzibar (Adjusted Parameter estimates = -4.521, CI: -5.92,-3.13) was having a lowest mean occurrence compared to Western zone and all other zones. The risk of malaria among under-five children was positively related with family wealth index. The results show that malaria decreases with an increase in wealth. Other explanatory variables which include; child sex, mother's age, marital status and education level, as well as mosquito net ownership were not statistically significant associated with malaria at 5% level. Therefore children's age, place of residence, zone of residence and wealth index are significant predictors of malaria in Tanzania. Particular emphasis on education and interventions across the groups need to be prioritized for continued improvements in targeting high prevalent areas to reduce malaria risks, especially to the children under-five years.

Key words: Malaria, children under five years, complementary log-log model.

INTRODUCTION

Globally there is a tremendous decrease in malaria infections, accounting 18% reduction from estimated 262 million malaria cases in 2000 to 214 million in 2015 (WHO, 2018). These contributed to a 60% reduction of

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mortality from the year 2000 to 2015. Malaria remains highest in Africa, and it is the fourth most significant cause of death for the children aged under-five years (WHO, 2015a, 2013). In the year 2015, about 306,000 deaths occurred globally and about 292,000 deaths in Africa (WHO, 2015b). Plasmodium falciparum is the main species causing malaria infections in children around sub-Saharan Africa. It is estimated that 90% of the mortality is caused by *Plasmodium falciparum* (Anstey et al., 2002; Nyarko and Cobblah, 2014; Walldorf et al., 2015).

In Tanzania, malaria is one of the leading cause of morbidity and mortality accounted for about one-third of all deaths for children under five years (Roach, 2012; Mboera et al., 2007). In the year 2007/2008 malaria indicator survey results reveal that 1(one) in every 5 (five) children were having malaria (URT, 2009). Research conducted in Muleba by Mushashu in the year 2012 shows that malaria prevalence for the under-five children was 26.3% (Mashashu, 2012). The work of Willilo et al. (2016) conducted in the lake zone (that is, Mara, Mwanza and Kagera Regions) reveals that the prevalence of Malaria for the infants was 11% (Figure 1). This calls for a need to use data covering all over Tanzania to find out the countrywide malaria prevalence and assess socio-demographic factors associated with malaria infections.

According to Nyarko and Cobblah (2014), there is an association between malaria of children under five with a region of residence, age, and mosquito net ownership. Another research conducted in Uganda by Roberts and Matthews (2016), found out that there is a relationship between Malaria infection of children under-five with mothers/caretaker education, and age of the children. The recent work of Nwoke et al. (2017) has shown that there is a relationship between income, mothers' occupation, and non-use of ITNs with under five malaria prevalence. That is why this study illuminates the socio-demographic factors associated with children under-five years in Tanzania by re-analysing recently Tanzania Demographic Health Survey of 2015-2016.

METHODS

Sources of data

This study used Tanzania demographic health survey data of 2015 to 2016. The children data were extracted from the Tanzania Demographic and Health Survey (TDHS) data which consists of all household members. The information extracted from the survey includes age, sex, marital status of the mother, education of the mother, and a relationship of the family member to the head of the household. Another information collected by these questionnaires were a source of water, type of toilet facilities, materials used for the floor, roof, and exterior walls of the dwelling unit, ownership of various durable goods and assets, and ownership and use of mosquito nets. Furthermore, information on malaria rapid test results and malaria using microscopy for the children aged 6-59 months were also extracted (TDHS, 2016).

In this study, a rapid diagnostic test (RDT) results for children aged 6-59 months was used as the response variable. According to WHO (2015), this measure is used to provide accurate, and it is a good proxy for measuring malaria in malaria-endemic areas. The selected independent variables were age of the child (grouped into five categories: less than 12; 12-23; 24-35; 36-47;48-59 months), sex of the child, age of the mother, place of residence, zone of residence, marital status of the mother; mother's level of education, wealth status, and ownership of mosquito net. These factors have been chosen based on the recent results presented by Anstey et al. (2002), Willilo et al. (2016) and Roberts and Matthews (2016).

Sample collection and procedure

According to the TDHS 2015-2016 report (Nwoke et al., 2017), the survey included 30 regions of which 25 were from Tanzania Mainland and five from Zanzibar. The 608 sample points were identified from those 30 regions based on 2012 Tanzania Population and Housing Census. A complete household listing for all 608 sample points identified was done. From the complete list, 22 households were systematically selected from each sample point (more detailed procedures are well elaborated in TDHS, 2015/2016 report). In our analysis, from 10,899 eligible under-five children, we excluded 1,577 children whose RDT malaria results were not properly recorded which leads to 9,322 under-five children to be selected.

Data analysis

A preliminary analysis was performed in which the relationship between each socio-demographic factor and malaria prevalence was examined using the chi-square test. The second analysis was done to determine predictors of malaria among children aged under-five years (Anstey et al., 2002) using the complementary log-log model. The data were analyzed using STATA Version 12. The complementary log-log model has been used because it is useful in epidemiological investigations when risk is of keen interest (Wacholder, 1986). The model was also used because of the malaria cases have asymmetrical distribution nature (Long, 1997) and the fact that, the outcome variable which has a dichotomous result that is either the children test positive(coded as 1) to malaria or negative (coded as 0). In many settings, a commonly model applied is to relate the mean response E(Y) and the explanatory variables linearly:

$$E(y) = \eta = \beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k$$

When the dependent variable is dichotomous, E(Y) is the probability of response p. The associated linear model can be generalized to

$$\begin{aligned} g(E(y)) &= g(\pi) \\ &= \beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k \end{aligned}$$

Where g is known as the link function (Mc- Cullagh and Nelder, 1989, sec. 2.2). The complementary log-log (CLL) model considered here is a variant under the assumption of binary response link functions such that:

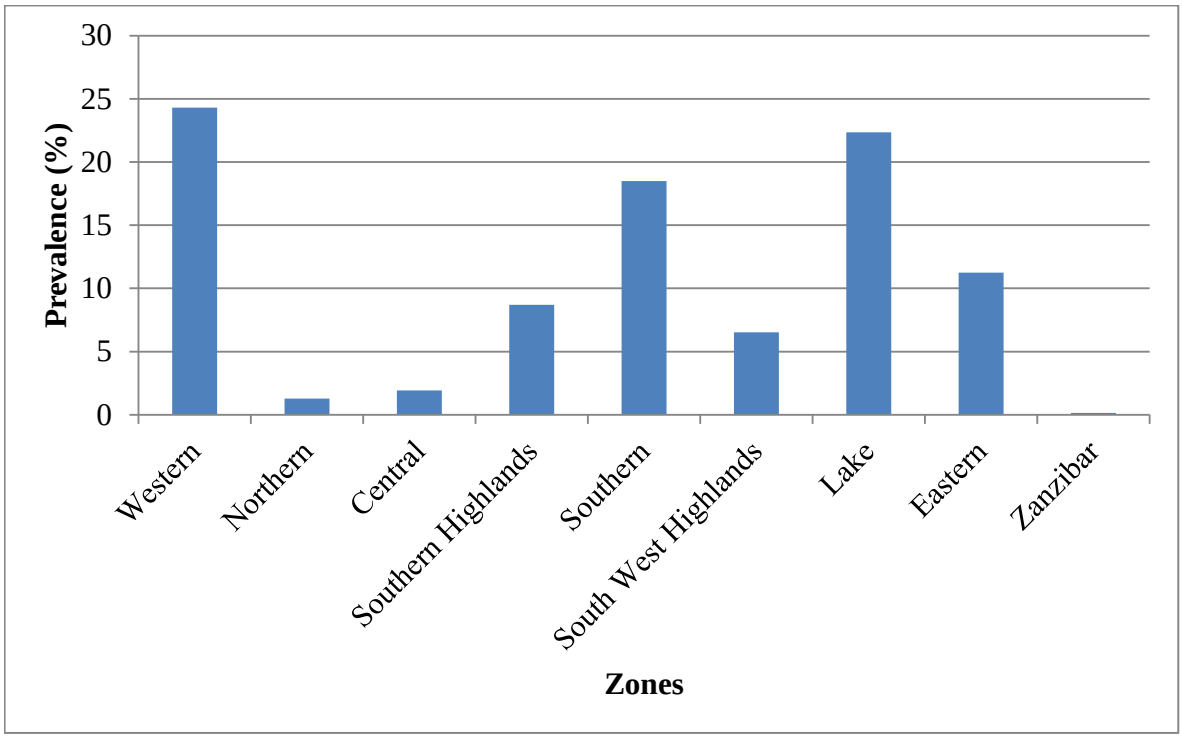

Figure 1. Prevalence of malaria for children under five years by zones.

$$\pi(y) = 1 - \exp[-\exp(\mathbf{X\beta})]$$
$$\log[-\log(1-\pi(y))] = \mathbf{X\beta}$$

Ethical issues

Tanzania's National Institute for Medical Research (NIMR), the Zanzibar Medical Ethics and Research Committee (ZAMREC), the Institutional Review Board of ICF International and the Centers for Disease Control and Prevention in Atlanta gave ethical clearance to the study. The re-analysis of the 2015-2016 TDHS data was requested from the measure Demographic and Health Survey (DHS) website, and we got approval to download the data.

RESULTS

Socio-demographic characteristics

According to Table 1, the result reveals that malaria prevalence increases with increase in age, its minimum to the children aged less than 12 months (6.7%) and highest to the children aged 48-59 months (14.8%). Regarding gender, although there was no significant difference noticed between males and females children (p=0.1), malaria prevalence was highest for the males at 12.53% compared to the females at 11.4%. No significant relationship also noticed between mothers age and malaria prevalence (p>0.05). Under five malaria occurrences were highest to those children mother's aged 40-49 years and lowest to those aged 15-19 years. There is a relationship between malaria prevalence with a place of residence and zones children belongs (p<0.05). The prevalence was highest in rural 14.4% whereas lowest in urban 3.6%. Malaria was also varied with zones. The Western zone was having the highest occurrence of 24.3% followed by Lake Zone 22.4% whereas it was lowest in Zanzibar with about 0.1%.

According to the result of statistical analysis, there was no significant relationship between mother's marital status and education level (p>0.05) in children infected with malaria while a statistically significant relationship between malaria of the children with wealth index (p<0.05). There were also changes in malaria prevalence with changes in mosquito net ownership. The occurrence being lowest to the families owning zero (6.8%) and highest being reported those owning more than four (18.4%).

Complementary log-log model

In univariable (unadjusted) analysis children age, place of residence, zone children belongs, marital status of the mother, wealth index and number of mosquito net

Table 1. Distribution of socio-demographic characteristics among the study group.

Variable	Frequency (%)		Chi-square P-Value
	RDT- Positive Results	RDT-Negative Results	
Children age (Months)			<0.0001
<12	71 (6.66)	995(93.34)	
12-23	218 (9.53)	2023 (90.27)	
24-35	252 (12.49)	1765 (87.51)	
36-47	274 (13.95)	1690 (86.05)	
48-59	301 (14.80)	1733 (85.20)	
Child Sex			0.1
Male	582 (12.53)	4064 (87.47)	
Female	534 (11.42)	4142 (88.58)	
Mother's age			0.434
15-19	67 (10.98)	543 (89.02)	
20-29	545 (11.91)	4031 (88.09)	
30-39	375 (11.80)	2804 (88.2)	
40-49	129 (13.48)	828 (86.52)	
Place of residence			<0.0001
Urban	74 (3.55)	2012 (96.45)	
Rural	1042 (14.40)	6194 (85.60)	
Zones			<0.0001
Western	216 (24.32)	672 (75.68)	
Northern	9 (1.29)	690 (98.71)	
Central	17 (1.91)	871 (98.09)	
Southern Highlands	57 (8.69)	599 (91.31)	
Southern	71 (18.49)	313 (81.51)	
South West Highlands	65 (6.52)	932 (93.48)	
Lake	592 (22.36)	2055 (77.64)	
Eastern	87 (11.25)	686 (88.75)	
Zanzibar	2 (0.14)	1388 (99.86)	
Marital status of the mother			0.126
Never Married	65 (15.08)	366 (84.92)	
Married/Living together	930 (11.82)	6939 (88.18)	
Widowed/Divorced/Not living together	121 (11.84)	901 (88.16)	
Mother's education status			
No education	230 (11.26)	1812 (88.74)	0.695
Primary	157 (12.41)	1108 (87.59)	
Secondary	522 (12.03)	3817 (87.97)	
Higher	207 (11.97)	1469 (88.03)	
Wealth index			<0.0001
Poorest	437 (20.56)	1688 (79.44)	
Poorer	353 (18.31)	1575 (81.69)	
Middle	229 (12.40)	1618 (87.60)	
Richer	97 (2.83)	3325 (97.25)	
Richest	10 (0.66)	1512 (99.34)	

Table 1. Contd.

Mosquito net ownership			<0.0001
0	135 (6.83)	1842 (93.17)	
1 – 2	330 (10.8)	2726 (89.2)	
3 – 4	375 (13.44)	2415 (86.56)	
>4	276 (18.41)	1223 (81.59)	

ownership was statistical significant ($p<0.05$) with children malaria prevalence (Table 2). The other variables which were child sex, age of the mother and mother's education level were not significant ($p>0.05$). In the adjusted Complementary log-log model only four variables were significant; child age, place of residence, zone which the under-five children belong and wealth index since $p<0.05$. Whereas child sex, mother's age, marital status and education level of the mother, as well as mosquito net ownership were not significant ($p>0.05$). However marital status and mosquito net ownership were significant in unadjusted Complementary log-log final model.

Malaria prevalence for the children increases with increase in age being lowest to the children under 12 months and highest for those aged 48-59 months (Adjusted Parameter Estimate (PA) =0.88, Confidence Interval (CI): 0.62-1.14). Although child sex was not significant, female children were having lower mean prevalence (PA=-0.099, CI: -0.22-0.02) compared to the male which was taken as the reference category. Malaria to the children varies with place and zone of residence, being highest to the rural areas (PA=0.481, CI: 0.21-0.75) compared to urban.

Complementary log-log model reveals that Western zone were also having highest mean occurrence of children malaria compared to all other zones. There were significant relationship between children malaria incidences with Northern (PA=-2.733, CI=-3.41,-2.06), Central (PA=-2.62, CI: -3.13,-2.11), Southern Highlands (PA= -0.787, CI: -1.10,-0.48), South West Highlands (PA= -1.291, CI: -1.58,-1.01), and Zanzibar (PA= -4.521, CI: -5.92,-3.13) zones. The remaining three zones that is Southern (PA= -0.233, CI: -0.51, 0.04), Lake (PA=-0.021, CI: -0.19, 0.14) and Eastern (PA= -0.064, CI: -0.33, 0.20) were not significant ($p>0.05$). The study reveals that Zanzibar was having lowest mean malaria children incidence (PA= -4.521, CI: -5.92,-3.13) compared to their counterparts from Western zone and all other zones.

DISCUSSION

The study re-analyzed 2015/2016 Tanzania Demographic Health Surveys data. It was noted that malaria cases were lowest for the children under one-year-old and cases were increased with increase in age. The fact that under one year children were having lowest cases of malaria may be due to antibodies acquired from their mother during pregnancy as the result they are capable of fighting malaria before their immunity wane (WHO, 2017; Michael-Phiri, 2017). This finding is also supported by Nyarko and Cobblah (2014) which was conducted in Ghana. Females experience lowest malaria cases as compared to their males counterpart. This may be due to biological reasons in which male are more susceptible to disease compared to female children. This study is consistent with the study conducted by Roberts and Matthews (2016) in Uganda and also with another conducted in Kenya by Sultana et al. (2017) which reveals that malaria cases were higher to males children compared to females.

It was also observed that malaria cases were highest in rural areas this may be due availability of good vector condition to multiply, lower housing quality, poverty, and poor drainage systems (Oladeinde et al, 2012). A similar result was obtained in Kenya by Sultana et al. (2017) which shows malaria cases were higher in rural areas than in urban setting. Furthermore, a study conducted in Sri-Lanka reveals that malaria is a disease for poor community living in rural areas (Fernando et al., 2003). This means the highest malaria cases rural Tanzania may be due to poverty which limits them to have modern houses and every family member to sleep in insecticide-treated bed nets. Malaria cases were also varying from one zone to the other being lowest in Zanzibar and highest in Western zone. The study by Hagenlocher and Castro (2015) supported this study in which they identified zones of high malaria risk cases being in the south-eastern and north-western part of the country. Their study also reveals that concentrations of high malaria cases were in north-western, western, and south-eastern zones. Although stable marriages are one among factors for physical well-being and healthier children (Staton, 2008) this study was contrary to this which shows there is no statistically significant relationship between malaria cases with marital status. Moreover, the results are supported by a study conducted in Ghana (Asiedu and Okwabi, 2014) which found a similar result.

The finding of this study regarding marital status was

Table 2. Estimates of a Complementary log-log model of the malaria for the Children under-five with socio-demographic characteristics.

Variable	Unadjusted			Adjusted		
	Parameter estimate	95% CI	P-Value	Parameter estimate	95% CI	P-value
Children age (Months)						
<12*						
12 to 23	0.395	[0.13,0.66]	0.004	0.423	[0.15,0.69]	0.002
24-35	0.661	[0.40,0.92]	<0.0001	0.654	[0.39,0.92]	<0.0001
36-47	0.779	[0.52,1.04]	<0.0001	0.779	[0.52,1.04]	<0.0001
48-59	0.843	[0.58,1.10]	<0.0001	0.88	[0.62,1.14]	<0.0001
Child sex						
Male*						
Female	-0.099	[-0.22,0.02]	0.1			
Mother's age						
15-19*						
20-29	0.086	[-0.17,0.34]	0.506			
30-39	0.076	[-0.18,0.34]	0.568			
40-49	0.219	[-0.08,0.51]	0.147			
Place of residence						
Urban*						
Rural	1.459	[1.22,1.70]	<0.0001	0.481	[0.21,0.75]	<0.0001
Zones						
Western*						
Northern	-3.068	[-3.74,-2.40]	<0.0001	-2.733	[-3.41,-2.06]	<0.0001
Central	-2.669	[-3.16,-2.17]	<0.0001	-2.62	[-3.13,-2.11]	<0.0001
Southern Highlands	-1.12	[-1.41,-0.83]	<0.0001	-0.787	[-1.10,-0.48]	<0.0001
Southern	-0.31	[-0.58,-0.04]	0.024	-0.233	[-0.51,0.04]	0.1
South West Highlands	-1.419	[-1.7,-1.14]	<0.0001	-1.291	[-1.58,-1.01]	<0.0001
Lake	-0.096	[-0.25,0.06]	0.228	-0.021	[-0.19,0.14]	0.797
Eastern	-0.848	[-1.10,-0.60]	<0.0001	-0.064	[-0.33,0.20]	0.635
Zanzibar	-5.266	[-6.66,-3.87]	<0.0001	-4.521	[-5.92,-3.13]	<0.0001
Marital status of the mother						
Never Married*						
Married/Living together	-0.262	[-0.51,-0.01]	0.041	-0.169	[-0.42,0.08]	0.191
Widowed/Divorced/Not living together	-0.26	[-0.56,0.04]	0.091	-0.176	[-0.48,0.13]	0.257
Mother's education status						
No education*						
Primary	0.103	[-.10,0.31]	0.318			
Secondary	0.07	[-0.09,0.23]	0.376			
Higher	0.098	[-0.09,0.29]	0.306			
Wealth index						
Poorest*						
Poorer	-0.13	[-0.27,0.01]	0.071	-0.148	[-0.29,-0.005]	0.043

Table 2. Contd.

Middle	-0.553	[-0.71,-0.39]	<0.0001	-0.393	[-0.56,-0.23]	<0.0001
Richer	-1.592	[-1.82, -1.36]	<0.0001	-1.074	[-1.32,-0.82]	<0.0001
Mosquito net ownership						
0*						
1 to 2	0.48	[0.28,0.68]	<0.0001	0.198	[-0.01,0.41]	0.067
3 to4	0.713	[0.52,0.91]	<0.0001	0.081	[-0.14,0.30]	0.475
>4	1.057	[0.85,1.26]	<0.0001	0.074	[-0.16, 0.31]	0.541

*Reference category.

different from that conducted by Houmsou et al., (2014) which found out that there was statistical significant relationship between children under five malaria status with mother's marital status. It was also observed that malaria cases were highest for the poorest families and decrease with increase in income. A study conducted in rural Uganda (Tusting et al., 2016) reveals the same results in which poorest families were more affected with malaria compared to the richest. Furthermore, a study conducted by Nonvignon and Jacob (2012) from four selected Sub-Saharan African countries found out that children from wealthier household were having the lowest risk as compared to poorest households. It should also be noted that Malaria in Africa is termed as an infectious disease of the poorest rural population and communities (Malaney et al., 2004).

Regarding the mosquito net, the findings are contrary to the study conducted in Ghana (Nyarko and Cobblah, 2014) which shows a significant association between mosquito net ownership with under-five malaria cases. In a study carried out in Nigeria (Yusuf et al., 2010) shows that malaria cases for children under-five were lowest to the household with mosquito bed net compared to those without nets. This study is also contrary to another study which was done in Tanzania (Somi et al., 2007) which shows that families owned mosquito nets or insecticide-treated bed nets were more likely to be protected from malaria parasites hence less malaria cases compared to the families without mosquito nets. Therefore, this need to be interpreted with care as most studies (Nyarko and Cobblah, 2014; Yusuf et al., 2010; Somi et al., 2007) concluded that there is highly relationship between mosquito net ownership with malaria cases of the under-five children.

Conclusion

The study concluded that the key determinants of the children under five malaria prevalence in Tanzania are children age, place of residence, zone in which respondents belong, and wealth index. Based on the finding, we recommend further research to be conducted to identify hot spots of malaria cases for targeting interventions. Adequate education should be given to mothers to make sure inclusive breastfeeding be maintained particularly during the first six months of the infants. Furthermore, the study recommends more initiative should be taken towards income-generating activities, especially to the rural population. This will potentially improve their access to interventions and proper treatment timely.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Bacteriology of Opa River, Ile-Ife, Nigeria and its public health implication on selected bordering areas

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This study determined the bacteriological quality of water from the Opa River and assessed the impact of human behaviour on the quality of water along the river course. Twenty five water samples were collected over a period of five weeks at five selected points based on population clusters along the river. A hundred questionnaire items were administered to randomly selected residents to elicit information about the water body and predominant communal behaviours. Water samples were analyzed by standard microbial techniques and isolates were identified. The isolates obtained were tested for their resistance to antibiotics via standard methods. Descriptive statistical techniques were used to obtain the minimum and maximum values of Total Heterotrophic Bacterial (THB) count and Total Coliform Bacterial (TCB) count. The analysis of variance (ANOVA) test was used to compare the means. Heterotrophic bacteria load at the five sampling points ranged between 2 x 10^6 and 13 x10^6 cfu/ml while the most probable number of coliforms in 100 ml of samples was between 34 and 1600. The organisms isolated from the samples included those of the Genera *Citrobacter Enterobacter Escherichia, Proteus, Klebsiella, Salmonella, Serratia, Yersinia, Shigella, Pseudomonas* and *Vibrio*. *Escherichia coli* had the highest percentage frequency of occurrence (23.73%) and was isolated at all sampling points. In all areas, communal behaviour towards the river was generally poor. Some respondents reported symptoms associated with water borne illnesses which included vomiting (28.5%), passing out of watery stool (57.2%) and headache and dizziness (14.3%). The Opa River was found to be mostly contaminated by multiple antibiotic resistant organisms. Opa River could be a source of potential pathogens associated with water borne diseases and could consequently; serve as a pathway for human contamination, most especially of dwellers located along its banks that depend on Opa River water.

Key words: Pathogens, waterborne disease, contamination, communal behaviours, antibiotic resistance.

INTRODUCTION

There has been noticeable increase in the number of Drinking and recreational water health related publication

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between 1980 and 2015. Research productivity on water related diseases from Asia and Africa have equally witnessed an upward increase in the last few years (Sweileh et al., 2016).

Waterborne diseases are rampant in sub Saharan Africa due to lack of access to clean water and poor sanitation. In Nigeria, contamination of drinking water with pathogens has also been reported in several towns (Olowe et al., 2016). Waterborne disease outbreaks occur either when public drinking water supplies are not adequately treated after contamination with surface water or when surface water contaminated with enteric pathogens is used for recreational purpose (Johnson et al., 2003).

In developing countries, the two main water problems man contends with are the quantity and quality of water (Adeniyi, 2004; Olajuyigbe, 2010a). Only about 58 per cent of Nigerians have access to safe water (UNICEF with WHO, 2012). Thus, most households have to resort to drinking water from wells and streams especially in the rural and suburban communities. These water sources are largely untreated and generally harbour pathogens causing waterborne diseases such as cholera, typhoid fever and hepatitis (Rahman et al., 2001; Adekunle, 2004; Fenwick, 2006).

Waterborne diseases are caused by pathogenic microorganisms which are directly transmitted when contaminated fresh water is consumed. Contaminated fresh water, used in the preparation of food, can be the source of water borne diseases. Many rivers, streams and wells worldwide are affected by faecal contamination leading to increased health risks to persons exposed to the water (Simmons, 1994; Obiri-Danso et al., 2009). Pathogenic bacteria that may be associated with faecal contamination include pathogenic strains of *Escherichia coli, Campylobacter species, Salmonella* species*, Shigella* species and *Vibrio cholerae*. In addition to these organisms causing human diseases, resistance to antibiotics has made treatment of the diseases they cause more difficult (Lamikanra and Okeke, 1997; Okeke et al., 2007).

According to the Nigerian Bureau of Statistics (NBS), cholera with symptoms of vomiting, watery stool, dehydration, fatigue, renal failure and occasional muscle cramps has been an extreme burden on Nigerians and often occurs rapidly and progresses to a large scale of outbreak (NBS, 2010).Newspapers in 2011 reported the death of one person and the hospitalization of 20 others following a cholera outbreak in Osogbo, the capital of Osun state. Also in 2012, a cholera outbreak at the Ede north and South Local government areas of Osun State left three people dead and 42 others hospitalized (Moses, 2012).

In Ile-Ife, between 2008 and 2010, scores of water borne disease incidence were reported in various primary health centers across the city. Following the reported cases, a high prevalence of typhoid was indicated with over 1000 cases in the city as well as other water borne diseases like diarrhorea with about 400 cases and dysentery with about 200 cases. However, only few cases of cholera were recorded in Ile-Ife within those periods (Olajuyigbe, 2010b).

This research investigated the bacteriological quality of water from the Opa River and how its specific usage affected public health. The objectives included identifying potential pathogens, evaluating pathogenic load in the river and assessing the prevalence of water borne diseases in the neighbouring communities. All of this was done to understand how the activities of people impacted the bacteriological quality of the water and how the quality of the water in turn affected health in the locations of interest. This would be used to create a model for sensitization of local residents on harmful practices that affect surface water quality and invariably, health.

MATERIALS AND METHODS

Study site

The Opa River's source is in Esa-Oke in Osun-State and flows through many towns and villages before emptying into the Osun River at Asejire. Five different points (Figure 1) along the Opa River which flows through Ile-Ife were purposively chosen for sampling based on the presence of bordering communities along the river banks and the fact that the water from the river along those points was being actively used for domestic activities such as cooking, bathing and washing, small scale industrial activities, recreational activities and agricultural activities. The sampling points were Ajebamidele community, Alakowe area of Ile – Ife, the Abattoir located at Ede road popularly called Odo- Eran and the Saw mill locally called the Iso-Pako or Oke-Opa area.

Data source and sample size determination

Data used for this study were obtained from water samples collected from the five sampling locations along the Opa River as well as the responses of residents along the 500 m buffer zone created using Arc GIS 10.1. This was within the bordering communities along which the water samples were collected. Questionnaires were used to elicit information on communal behavior prevalent in the bordering communities in terms of water usage, water management, waste and sewage disposal methods and the prevalence of water borne diseases in the community.
The sample size was determined using the equation:

Necessary Sample Size = $(Z_{\alpha}^{2}*\sigma^{2})/d^{2}$ for an unknown population size (Smith, 2013), where Z-Score used was 1.645 based on the confidence level of 90%; standard deviation of 0.5 was used and a margin of error (Confidence Interval) of 8% was used.

Sample size = $((1.645)^{2} \times 0.5(1-0.5)) / (0.08)^{2}$
$(2.7060 \times 0.25) / 0.0064$
$0.6765/0.0064=105.7$

Study design and selection of sampling points

The study employed a cross-sectional study design. Five sampling

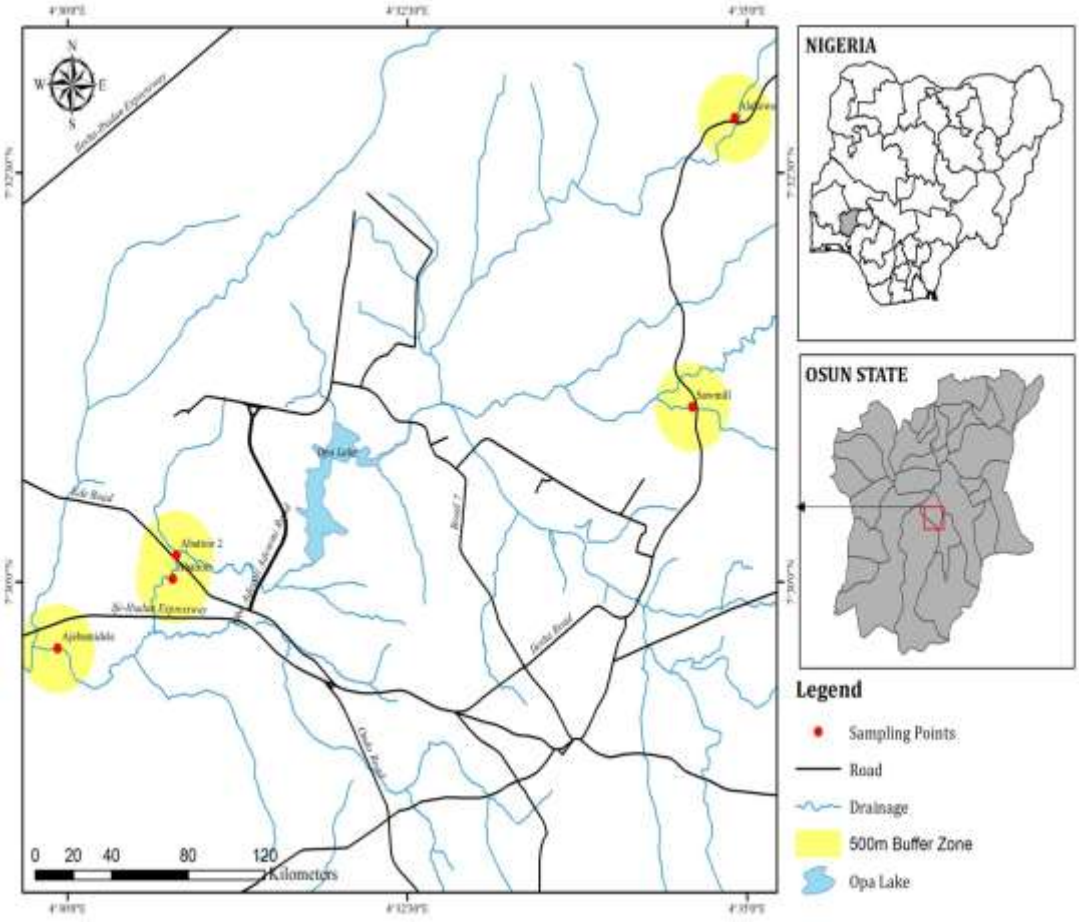

Figure 1. Map of study site showing sampling points and 500 m buffer zone.

points were selected purposively taking into consideration accessibility, availability of human settlements, and anthropogenic activities (domestic, small scale industrial and agricultural activities). The site locations and coordinates of the sampling points (Table 1) were determined using a portable global positioning system (GPS) set.

Sample collection

Twenty five water samples were collected from pre-selected sampling points (Table 1) over a period of five weeks from 25th August 2015 to 22nd September 2015. At each sampling point, sterile specimen bottles were used to collect water for bacteriological analysis. All surface water samples were collected directly by removing the cover cap and with the mouth facing upstream, plunging it downwards below the water surface. It was then slightly tilted upwards for the container to be completely filled with water. The water samples were placed in an insulated cold box and immediately transported to the microbiology laboratory for analysis.

A total of 100 questionnaires were distributed to residents to inquire about water use pattern and waste disposal practices in the study areas. Data from the questionnaires were analyzed using the SPSS statistical tool for descriptive and inferential analysis.

Enumeration of total heterotrophic bacteria

The number of viable bacteria in water sample was estimated based on standard techniques recommended in the Methods for the Examination of Water and Waste Water (APHA, 1998). A ten-fold serial dilution was done to thin out bacterial population in samples. 1 ml of serially diluted water samples was withdrawn and plated aseptically into properly labeled petri dishes. Then, about 20 ml of nutrient agar kept in molten form at 45°C in water bath to prevent heavy condensation was poured over the water sample and mixed properly by tilting and rotating the Petri dish on the work bench to ensure formation of a uniform layer as well as to prevent spilling. This was first done in a clock wise direction, then in an anti-clockwise direction, later to the left and to the right and finally, forwards and backwards to ensure that the microbes were well dispensed in the medium. The agar plates were allowed to set after which the plates were inverted and incubated at 35 ± 2°C for 24 h. After the incubation period, the plates were observed for growth and selected for count. The cultured plates in which the number of colonies fell within the statistically accepted range of number of colonies (that is 30 to 300 COLONIES per plate) and their respective duplicates were selected and counted. The average count per plate was multiplied by the reciprocal of the dilution factor at that dilution and expressed as the number of colony forming units (cfu) per milliliter of the original water sample. This represented the

Table 1. Site description and coordinates of sampling points.

Sampling location Code	Sampling point	Latitude (North)	Longitude (East)	Altitude (Meters)
A	Ajebamidele	7.493194	4.498778	233
B	Ede Road Abattoir	7.500030	4.512915	230
C	After Abattoir	7.502697	4.513340	231
D	Sawmill (Iso-Pako) Oke-Opa	7.51780	4.57722	267
E	Alakowe	7.54722	4.58180	282

viable cell count. Counting of colonies on plate was done manually.

Enumeration of total coliform bacteria

The most probable number (MPN) technique as described by American Public Health Association was employed for bacteria enumeration. The tubes in the first row held 10 ml of double-strength MacConkey broth as presumptive medium while the tubes in the second and third rows contained 10 ml of single-strength presumptive medium. With a sterile syringe, 10 ml of original water sample was aseptically inoculated into each of the five test tubes in the first row and 1 ml of water sample was also inoculated into each of the five tubes in the second row. For the third row of the last set of five test tubes, a 1:10 dilution was carried out on the water sample after which 1 ml of the 1:10 diluted sample was inoculated into each of the five test tubes in the third row. Durham tubes were inserted in all test tubes and corked for possible gas collection. The cultured tubes were carefully agitated to mix and dispense the inocula within the broth medium. They were incubated at 35°C for 72 h. Each tube was observed for microbial growth which was indicated by gas production and cultured media turbidity. The combined numbers of positive tubes in each set of arranged test tubes in order of least diluted to the most diluted was read out from the standard 5 tube MPN table to obtain the estimated number of coliform cells present in 100 ml of the original water sample. Also, positive broth cultures were sub-cultured on MacConkey agar, incubated for 24 h to isolate pure culture of organisms (APHA, 1998).

Isolation and identification of *Vibrio cholerae*

Double strength alkaline peptone water was used as enrichment medium for *Vibrio Cholerae*. After preparation, 5 ml of the double strength alkaline peptone water was dispensed into MacCartney bottles and sterilized at 121°C for 15 min. The peptone water was standardized to the required pH of 8.6 and 5 ml of the water sample to be cultured was then dispensed into each MacCartney bottle containing the sterile double strength enrichment medium using sterile syringe and incubated at 35°C for 24 h. After incubation, sub culture was made on thiosulfate-citrate-bile salts-sucrose (TCBS) agar plates and plates were incubated at 35°C for 24 h. Suspicious yellow colonies were gram stained and tested for motility and oxidase production according to the methods of Theron et al. (2000).

Anti-microbial susceptibility test

Sensitivity of pathogenic bacteria to different classes of antibiotics was assessed by disc diffusion method using ABTEK DT NEG-1 sensitivity discs. Sterile Diagnostic Sensitivity Test (DST) Agar was prepared along with a 0.5 MacFarland equivalent standard of an 18-24 h old pure culture of the test organisms. The standard organism solution (in peptone water) was flooded through the surface of the agar plate and allowed to dry for 15 to 20 min under the laminar air flow to pre-diffuse before sterile Gram negative antibiotics disc containing: Augmentin (30 µg), Ofloxacin (5 µg), Gentamicin (10 µg), Nalidixic acid (30 µg), Nitrofurantoin (200 µg), Cotrimoxazole (25 µg), Amoxycillin (25 µg) and Tetracycline (25 µg) were placed gently on the surface of agar plates with sterile forceps to avoid deformation of the agar. The plates were incubated at 35°C for 24 h, after which the clear zone of inhibition was observed and measured using a millimeter rule. The values obtained were then compared with a recent inhibition standard table and strains were classified as sensitive, intermediate or resistant (Cowan and Steel, 1993).

RESULTS

Bacteriology of the Opa river and distribution of isolates

The bacteriological flora (Table 2) of water samples examined in a period of five weeks along the Opa River comprised a total of 14 distinct species of isolates that were well replicated in almost all of the five sampling points. The isolates belong to the same phylum (proteobacteria) and class (gammaproteobacteria), three different orders and families (Enterobacteriaceae, Pseudomonaceae, Vibrionaceae) as well as eleven distinct genera. They are: *Citrobacter koseri, Enterobacter aerogenes, Escherichia coli, Proteus mirabilis, Klebsiella aerogenes, Citrobacter freundii, Klebsiella pneumoniae, Salmonella typhi, Pseudomonas aeruginosa, Proteus vulgari, Serratia marcescens, Yersinia enterocolitica, Shigella dysentariae* and *Vibrio cholera* and are presented in Table 2 alongside their distribution across various sampling points. Furthermore, water samples from all points were positive for potentially pathogenic organisms (coliforms and some other bacteria capable of causing water borne disease). However, Ajebamidele showed the highest frequency of occurrence for all pathogens except *Vibrio cholera*, *Enterobacter aerogenes* and *Proteus mirabilis* (Figure 2).

Table 2. Frequency/percentage frequency of occurrence of Isolates across sampling points.

Isolated Pathogens	Sampling points						
	Ajebamidele	Ede Road Abattoir	After Abattoir	Oke-Opa	Alakowe	Frequency of occurrence	% F (N=118)
Citrobacter koseri	+	+	+	-	+	6	5.08
Enterobacter aerogenes	+	+	+	-	-	6	5.08
Escherichia coli	+	+	+	+	+	**28**	**23.73**
Proteus mirabilis	+	+	+	-	+	4	3.39
Klebsiella aerogenes	+	+	+	+	+	7	5.93
Citrobacter Freundii	+	+	+	+	+	9	7.63
Klebsiella pneumonia	+	+	+	+	+	7	5.93
Salmonella typhi	+	+	+	+	+	**15**	**12.71**
Pseudomonas aeruginosa	+	+	+	+	+	7	7.63
Proteus vulgaris	+	+	-	-	-	3	2.54
Serratia marcescens	+	-	-	-	-	2	1.69
Yersinia enterocolitica	+	+	-	-	-	3	2.54
Shigella dysenteriae	+	+	+	+	+	**12**	**10.17**
Vibrio cholera	+	+	+	-	-	**9**	**7.63**

- Absent; +, Present.

Table 3. Descriptive statistics of bacteria load at Opa river.

Parameter	THB (Cfu/ml×10^6)	TCB (per 100 ml)
N	25	25
Min	2	34
Max	14	1600
Mean	6.68	969.36
Std. Error	0.76751	126.05611
Standard deviation	3.83753	630.28055
Skewness	0.584	-0.039
Kurtosis	-0.941	-1.979

THB, Total Heterotrophic Bacterial Count; TCB, Total Coliform Bacterial Count; Min, Minimum Value; Max, maximum value.

Table 4. ANOVA Statistics for Variation across Sampling Points of THB and TCB Counts in all sampling periods.

Count	N	Mean±SD	F	$P_{0.05}$
THB	25	6.68±3.83753	6.973	0.001**
TCB	25	969.36±630.28055	2.067	0.123

THB, total heterotrophic bacterial count; TCB, total coliform bacterial count.

Bacteriological load of the Opa River

Total heterotrophic bacterial (THB) count

The total heterotrophic bacteria (THB) count (Table 3) in Opa River ranged from 2×10^6 to 14×10^6 cfu/ml with a mean of 6.68×10^6 cfu/ml and a standard deviation of 3.84×10^6. The highest THB of 12×10^6 to 14×10^6cfu/ml count was recorded at Ajebamidele in all sampling periods. There was significant difference ($P<0.05$) in the total heterotrophic bacteria count across the various sampling points (Table 4).

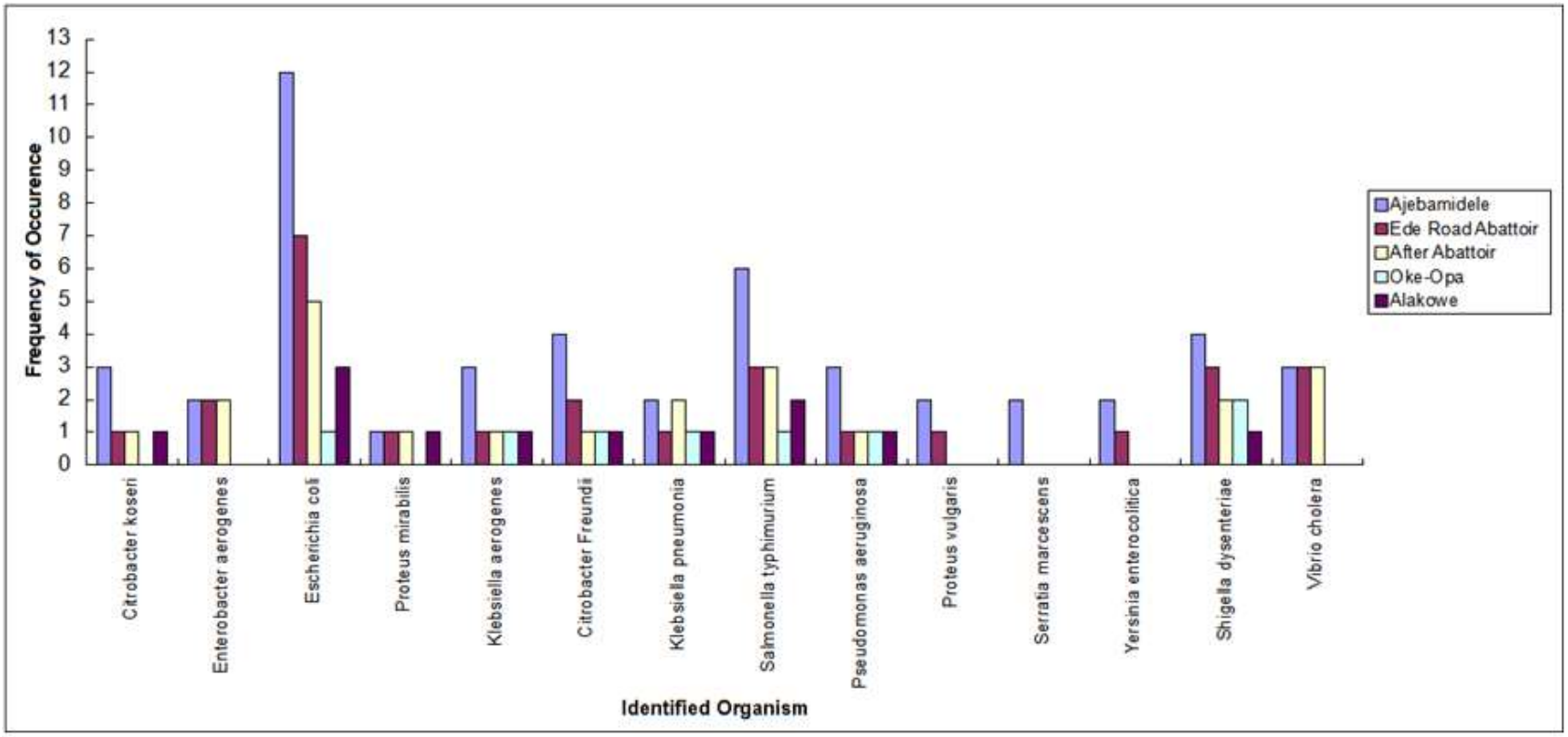

Figure 2. Frequency of Occurrence of Isolates along Sampling Points.

Total coliform bacterial (TCB) count

The total coliform bacteria (TBC) count (Table 3) in Opa River across all points of sample collection ranged from 34 to 1600 per 100 ml of water sample analyzed with a mean of 969.36 and standard deviation of 630.28. The highest TCB count was recorded at Ajebamidele in all sampling periods although there was no significant difference (P>0.05) in total coliform bacteria count across the various sampling points (Table 4).

Water usage at the bordering areas

Water usage practice across the bordering areas was queried (Table 5). While 100% of respondents claimed not to engage in direct use by drinking, a majority of them (Ajebamidele, 70%; Ede Road Abattoir, 50%) attested to the fact that water from Opa River was used for domestic, agricultural, recreational, industrial and even spiritual purposes.

Waste and sewage management practices at bordering areas

Self-collection was the predominant form of waste collection in all the areas bordering Opa River that

Table 5. Water usage at the bordering areas.

Variable	Options (N=20)	Sampling Points										ANOVA	
		Ajebamidele		Abattoir		After Abattoir		Oke Opa		Alakowe		F	$P_{0.05}$
		F	%	F	%	F	%	F	%	F	%		
Is Opa water used?	Yes	14	70	10	50	6	30	7	35	5	25	7.755	0.001
	No	6	30	10	50	14	70	13	65	15	75		

Table 6. Waste and sewage practices at bordering areas.

Variable	Options	Sampling Points										ANOVA	
		Ajebamidele		Abattoir		After Abattoir		Oke Opa		Alakowe		F	$P_{0.05}$
		F	%	F	%	F	%	F	%	F	%		
Who collects the waste from your household?	Private waste collection	0	0	0	0	0	0	0	0	0	0	8.143	0.001
	Self-disposal	14	70	20	100	20	100	20	100	20	100		
	Government	6	30	0	0	0	0	0	0	0	0		
	Other means	0	0	0	0	0	0	0	0	0	0		
Alternative means of waste disposal	Water body	13	65	20	100	20	100	20	100	20	100	10.23	0.001
	Burning	7	35	0	0	0	0	0	0	0	0		
What system of sewage disposal is employed in your household?	Pit latrine	6	30	16	80	15	20	0	0	4	20	2.701	0.035
	Water closet system	2	10	4	20	5	80	20	100	13	65		
	None of the above	12	60	0	0	0	0	0	0	3	15		
If none, how is sewage disposed by you?	Water body	12	60	0	0	0	0	0	0	3	15		
	Buried	0	0	0	0	0	0	0	0	0	0		

were investigated (Table 6). In all bordering areas, 100% of respondents indicated that wastes were self disposed except for Ajebamidele. The major method of waste and sewage disposal was by dumping them into the Opa River as it was the most convenient form of disposal for respondents who live along the River bank. There was also significant difference ($P<0.05$) in waste collection methods, waste disposal methods and sewage disposal methods across all bordering areas.

Communal behaviour towards the Opa River

The communal behavior of occupants at the bordering areas towards the water body was generally poor (Table 7). It was observed that solid wastes, sewage and urine were indiscriminately thrown into the water body. In addition, agricultural wastes and waters from the local oil producing industry were dumped into the water body at Ajebamidele and Ede Road Abattoir while animal dung and other wastes were thrown into the Opa River. The river is also being used for spiritual baths and cleansing at Ajebamidele and Alakowe respectively.

Period prevalence of water borne disease at bordering areas and antibiotic susceptibility pattern of isolated bacteria to test antimicrobial agents

About 35% of the respondents at Ajebamidele experienced different symptoms related to water borne diseases. Five out of 7 of the respondents experienced the symptoms in a period of less than a week before the investigation was conducted while 2 suffered from such symptoms less than a month before the questionnaires were retrieved.

The antibiotic susceptibility pattern of bacteria isolated and identified at the Opa River was tested using eight antibiotics (Table 8) namely, Augmentin, Oflaxacin, Gentamicin, Nalidixic acid, Nitrofurantoin, Amoxicillin, Tetracycline and Cotrimazole (Table 8). Coliforms and other bacteria capable of causing water borne diseases

Table 7. Communal Behaviour towards Opa River at the bordering Areas.

Variable	Options	Sampling Points									
		Ajebamidele		Abattoir		After Abattoir		Oke Opa		Alakowe	
		F	%	F	%	F	%	F	%	F	%
Children play in it?	Yes	20	100	20	100	20	100	20	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
People urinate and excrete at the bank?	Yes	20	100	20	100	20	100	20	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
Is domestic waste thrown into it?	Yes	20	100	20	100	20	100	20	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
Is agricultural waste thrown into it?	Yes	20	100	20	100	20	100	20	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
Do people bath/swim in it?	Yes	20	100	20	100	20	100	20	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
Is it used for spiritual cleansing	Yes	20	100	0	0	0	0	0	0	20	100
	No	0	0	20	100	20	100	20	100	0	0

Table 8. Antibiotic susceptibility pattern of isolated bacteria to test antimicrobial agents.

Bacteria	MAR pattern	Number of Antibiotics Showing Bacteria Resistance	Percentage resistance of isolated bacteria
Salmonella typhi	AUG, NAL, NIT, AMX, TET, COT	6	75
Proteus vulgaris	AUG, NAL, NIT, AMX, COT	5	62.5
Shigella dysentariae	AUG, OFL, GEN, NAL, NIT, TET	6	75
Klebsiella pneumonia	AUG, NAL, NIT, AMX, TET, COT	6	75
Pseudomonas aeruginosa	AUG, AMX, TET, COT	4	50
Citrobacter freudii	AUG, NAL, NIT, AMX, TET, COT	6	75
Serratia marcescens	AUG, NAL, AMX, TET, COT	5	62.5
Yersinia enterocolitica	AUG, OFL, GEN, NAL, NIT, AMX, TET, COT	8	100
Escherichia coli	AUG, OFL, GEN,AMX, TET,	5	62.5
Klebsiella aerogenes	AUG, OFL, GEN, NAL, NIT, AMX, TET, COT	8	100
Vibrio cholerae	AUG, OFL, GEN, NAL, NIT, AMX, TET, COT	8	100

AUG-Augmentin; OFL, Ofloxacin; GEN, gentamicin; NAL, nalidixic acid; NIT, nitrofurantoin; AMX, amoxycillin; TET, tetracycline; COT, Cotrimazole; R, resistant; S, sensitive. Percentage (%) =f/N, where N = 8 (total number of antibiotics used) and f represents frequency of resistance per isolate.

(*Salmonella* Typhimurium 75%, *V. Cholerae* 100%, *K. aerogenes* 100%) were more resistant than sensitive to the antibiotics used.

Comparison of THB and TCB Counts to WHO and NIS Permissible Standards

THB and TCB counts of the twenty five water samples were compared to the World Health Organisation Permissible levels as well as the Nigerian Standard for drinking water quality permissible levels as presented in Tables 9 and 10.

DISCUSSION

All identified potential pathogens were either coliforms, which are indicators of feacal contamination, or other potentially pathogenic bacteria capable of causing water

Table 9. THB Count in Opa River in Comparison with the WHO and NIS Permissible Levels.

Sampling Periods	Ajebamidele	Ede Road Abattoir	After Abattoir	Oke-Opa	Alakowe	MPL (NIS 2007)	MPL (WHO 2007)
SP 1	12	5	7	2	4	10	100
SP 2	13	4	3	5	5	10	100
SP 3	10	9	3	6	6	10	100
SP 4	14	2	12	5	5	10	100
SP 5	13	4	2	7	7	10	100

Table 10. TCB Count in Opa River in Comparison with the WHO and NIS Permissible Levels.

Sampling Periods	Ajebamidele	Ede Road Abattoir	After Abattoir	Oke-Opa	Alakowe	MPL (NIS 2007)	MPL (WHO 2007)
SP 1	1600	1600	1600	34	540	0	1
SP 2	1600	540	540	540	350	0	1
SP 3	1600	540	540	1600	1600	0	1
SP 4	1600	350	180	350	350	0	1
SP 5	1600	1600	180	1600	1600	0	1

borne illnesses. This agrees with the work of Abdu et al. (2013) who also reported the contamination of Opa River by coliforms and other pathogens after microbiologically analyzing water from five locations along Opa River.

E. coli, as observed in this study showed the highest frequency of occurrence (23.73%) across the five sampling points. The high occurrence of *E. coli* in water samples at all points indicates recent and probably continuous fecal contamination of the water from River Opa by human activities and unhygienic behaviours of people living at the river banks which were identified by questionnaires specifically as excreting and urinating by the river bank due to lack of proper sewage disposal methods in the bordering areas. Ihejirika et al. (2011), in a similar study, attributed the isolation of *E.coli* in relatively high percentages from the Imo River to human activities. *S. typhi* showed the second highest frequency of occurrence (12.71%) across all sampling points. it is also corroborated by the findings of Arvanitidou et al. (2005) in Northern Greek waters that were used for recreational purposes.

V. cholerae was isolated from 8% of the water samples and its presence in water samples may have been due to animal contamination from birds, frogs, toads, crabs and fishes usually present in aquatic environments. The pathogen may have been introduced into the water from human feaces due to defecation along the river bank by dwellers of the bordering areas as reported by Ali et al. (2001). The presence of *Shigella spp*. (10.17%) in water samples might be due to the unsanitary condition of the areas bordering the Opa River most especially in Ajebamidele and Ede Road Abattoir and secondary fecal contamination from intermediary sources. Ihejirika et al. (2011) reported a 100% isolation of *Shigella spp* from water sources in Ahiazu Mbaise and the implication of such result was reported as a possible outbreak of shigellosis Emch et al. (2008).

The occurrence of *Citrobacter spp*, *Klebsiella* spp., *Enterobacter* sp. and other members of the family enterobacteriaceea in water samples from Opa River indicates further feacal contamination of the river as these pathogens are normally found in the gastrointestinal tracts of humans. While investigating the possible diarrheal disease potentials of water sources in Ahiazu Mbaise, Eastern Nigeria, Esomonu et al. (2012) identified similar organisms and reported their ability to cause infections in humans. All the pathogens isolated showed a pattern of multiple antibiotic resistance to the common antibiotics used in the susceptibility testing. *S. typhi* for instance recorded a 75% resistance to the following antibiotics: Augmentin, nalidixic acid, nitofuratoin, amoxicillin, tetracycline and cotrimazole. Isolated *V.cholerae* also showed a 100% resistance to all antibiotic used.

The pathogenic load recorded at each sampling point exceeded the World Health Organisation (WHO) and Nigeria Industrial Standard (NIS) permissible levels. Across all sampling points at all sampling periods, THB count showed a mean value of 6.68×10^6 cfu/ml of water sample analysed while TCB count, showed a mean value of 969.36 per 100 ml of water examined. These values extremely exceed the Nigerian standard for drinking

water quality (NIS 2007) and the WHO (2007) recommended limits for potable water. The Nigerian standard for drinking water recommends that the maximum permitted level (MPL) for human drinking water must not exceed 10 cfu/ml for heterotrophic bacteria count, 0 cfu/100 ml for total coliform count and 0 cfu/100 ml for *E. coli*, feacal *Streptococcus* and *C. Perfringes* spores, respectively (NIS, 2007). Also, freshwater quality criteria for domestic supply require that faecal bacteria levels should not exceed a geometric mean value of 100 cfu/100 ml while the drinking water criterion is 1 cfu/100 ml (WHO, 2001).

A high THB count is generally regarded as an indicator of poor biological quality of water (USEPA, 2003). The high levels of faecal bacteria recorded in this study as well as the presence of pathogens in the river clearly indicate that the Opa River receives faecal contaminants on a continual basis. This may be due to the fact that its tributaries are highly impacted by commercial, semi-industrial and domestic activities but the Ajebamidele and Ede Road tributaries may be considered as the most impacted due to direct sewage discharge from most homes in the Ajebamidele community into the river body and waste discharge from the dressing of carcasses at the slaughter house at the Ede Road Abattoir respectively.

All of these practices may predispose members of the bordering areas to water borne illnesses. However, members of the Ajebamidele community may be more vulnerable due to the fact that the highest pathogenic load values were recorded at Ajebamidele and most isolated coliforms and other pathogens capable of causing water borne diseases like *E.coli, Salmonella typhi* and *Shigella* spp. showed highest occurrence frequency at Ajebamidele than the other four bordering areas. This, coupled with the water usage system obtainable at Ajebamidele may make dwellers more vulnerable to water borne diseases than in the other four areas. Also, symptoms related to water borne illnesses were only observed at Ajebamidele. This is substantiated by the findings of Nwidu et al. (2008) which reported the frequent diagnosis of cholera, dysentery, typhoid fever and diarrhea in the Niger Delta region of Nigeria due to high levels of feacel contamination in River Amassoma.

Conclusion

Based on the findings from this study, it could be said that River Opa, which runs through many rural and semi-urban communities in Osun State, is contaminated with a wide array of antibiotic-resistant bacteria and potential pathogens that could predispose its users to water borne diseases. Therefore, water from the river may be unsuitable for domestic engagements without appropriate treatment measures as it could serve as a pathway for human contamination, most especially to dwellers located along its banks.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Assessment of the unmet needs of contraception among female undergraduate students in southern Nigeria

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The proportion of women who have an unmet need for modern contraception is highest (24%) in Sub-Saharan Africa, which is double the world average of 12% in 2015. This unmet need leads to unintended pregnancies, unsafe abortions and limitation of women's ability to achieve educational, employment and economic goals. This study aims to assess the unmet needs of contraception and the reasons for contraceptive non-use among female undergraduate students in Benin City. A descriptive cross-sectional study was conducted on female undergraduate students in Benin City, Edo State from January to June, 2017. The respondents were selected using multistage sampling technique. Data was collected using pre-tested structured self- administered questionnaires and data analysis was by IBM SPSS version 21.0. The level of significance was set at $p < 0.05$. Results revealed that a total of 400 respondents with mean age (SD) of 21.3 (2.5) years participated in this study. One hundred and sixty-one (40.2%) respondents were sexually active and of these, 128 (79.5%) had ever used contraceptives. However, only 97 (76.4%) of those who had sexual exposure within the past 1 month were currently using contraceptives. The unmet need of contraception was 18.6%. Reasons for unmet need included partner's disapproval 24 (80.0%), fear of side effects 12 (40.0%) and religious beliefs 8 (20.0%). Thus, unmet need of contraception was high among the study group. Concerted efforts of relevant stakeholders will ensure universal access to sexual and reproductive health care services.

Key words: Benin City, contraception, undergraduate, unmet needs

INTRODUCTION

The concept of "unmet need for contraception" which refers to the proportion of women who do not want to become pregnant but are not using contraception has been used in the international population field since the1960s (PRB, 2016). It has influenced the development of family planning programs for several decades, and

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several years ago, unmet need was added as an indicator to Millennium Development Goal (MDG) 5, improving maternal health (PRB, 2016). Family planning is also an aspect of the targets around universal access to sexual and reproductive health found in the Sustainable Development Goals (SDG 3.7 and 5.6) (Dockalova et al., 2016).

Worldwide in 2015, 12% of married or in-union women were estimated to have had an unmet need of not using an effective family planning method (UNPFA, 2016). The level was much higher (22%) in the least developed countries. Many of the latter countries are in sub-Saharan Africa, which is also the region where unmet need was highest (24%), which doubles the world average in 2015 (UNPFA, 2016). In developing countries, about half of sexually active women of reproductive age, or 818 million women want to avoid pregnancy, but 17% (140 million) are not using any method of family planning, while 9% (75 million) are using less-effective traditional methods (Darroch et al., 2011). According to the Nigeria Demographic Health Survey done in 2013, the overall unmet need for contraception in Nigeria is 16% (NPopC and ICF Marco, 2014).

The reproductive health status of women and girls in West Africa is extremely poor compared with other regions and is further undermined by unintended pregnancies resulting mostly from unmet need for contraception, which often result in deaths and injuries from abortions provided in unsafe conditions. Unintended fertility fuels a rate of population growth that outpaces the region's efforts to meet the social needs of its citizen and achieve national development goals (USAID, 2005). Unmet need for contraception could also lead to limitation of women's ability to achieve educational, employment and economic goals (Oluwasanmi, 2010).

A country/region may have unmet needs for a variety of reasons. In Sub-Saharan Africa, the leading reasons are concerns about adverse health effects/side effects and opposition to use by the woman or her partner (Darroch et al., 2011). In Nigeria, the reasons given by a greater proportion of women included being not disposed to using contraception, partner opposition, lack of knowledge, a fear of side effects and religious prohibition (NPopC and ICF Marco, 2013). The Nigeria Family Planning Blueprint (Scale Up Plan), was drawn to meet these unmet needs in Nigeria and seeks to increase women's use of FP services and contributes to the reduction of maternal mortality by 75% and infant mortality by 66% across Nigeria by 2018 (FP2020, 2012). Meeting the current need for modern contraception would reduce pregnancy-related deaths by 79,000 in the developing world and most of this reduction- a drop of 48,000 maternal deaths- would take place in Sub-Saharan Africa.

The environment in higher institutions of learning, which is where this study was carried out, is characterized by high levels of personal freedom and social interaction. This social interaction often translates to sexual interaction. Permissive sexual lifestyle in higher educational institution in Nigeria and a number of other African countries have been documented as featuring a high level of risky sexual behaviors including unprotected casual sex (Aigbiremolen et al., 2014). The unmet need for contraception among female undergraduate students in Benin City was therefore assessed with a view to providing information to policy makers and planners that will be used to improve contraceptive uptake among these students.

MATERIALS AND METHODS

The study utilized a descriptive cross-sectional study design. The study population comprised female undergraduate students of the University of Benin, Benin City, Edo State from January to June, 2017. A minimum sample size of 377 using the formula for single proportion was calculated (Suresh and Chandrashekara, 2012) using a prevalence rate of contraceptive use in a study conducted among female undergraduate students in Edo State (Oluwasanmi, 2010). Multi-stage sampling technique comprising three stages was used to select respondents. In stage one, the list of the 14 faculties in the University of Benin was obtained and seven were selected using simple random sampling technique by balloting. From each selected faculty, simple random sampling technique by balloting was used to select one department from the list of departments by balloting in stage two. In the third stage, stratified random sampling technique was used to select respondents from all the levels in the selected departments. The sampling fraction was calculated by dividing the calculated sample size by the total population of undergraduates in the selected departments. The sampling fraction was then used to multiply the total number of students in each level in order to obtain the number of students from each level that were to be recruited in this study. Using simple random sampling by computer generated numbers, the required number of respondents from each level was selected.

Data was collected using a structured self-administered questionnaire comprising both open and closed ended questions and consisting of 3 sections. Section A sought information on the socio-demographic characteristics of the respondents, Section B sought information on sexual and contraceptive history, while Section C sought information on factors affecting contraceptive non-use among respondents. The questionnaires were pre-tested in another tertiary institution, College of Education, Ekiadolor, Edo State. Pre-testing was done to aid standardization and validation of the questions and objectives of this study. Approval for this study was given by the Department of Community Health, School of Medicine, University of Benin, Benin City and the University of Benin Ethics Committee. Permission was obtained from the Vice Chancellor of the University of Benin and the Heads of selected departments before the study was carried out. Informed consent was obtained verbally from the respondents and they were assured of voluntary participation, confidentiality of their responses and the opportunity to withdraw at any time without prejudice.

The questionnaires were screened for completeness by the researcher after which they were coded, entered into the IBM SPSS version 21.0 software and analysed. Unmet needs of contraception was calculated by dividing (the number of women of reproductive age (15 to 49 years) who are married or in union with an unmet need for family planning + number of single women who had sexual intercourse without contraceptives) by (total number of women of

Table 1. Socio-demographic characteristics of respondents.

Variable	Frequency (n =400)	Percent (%)
AGE group (years)		
<18	19	4.7
18-20	142	35.5
21-23	163	40.7
24-26	63	15.8
>26	13	3.3
Religion		
Christian	384	96
Islam	16	4
Marital status		
Single	389	97.2
Married	6	1.5
Cohabiting	5	1.3
Department		
Pharmacy	83	20.8
Medicine	65	16.2
Plant Biology and Biotechnology	64	16
Banking and Finance	58	14.5
Soil Science	54	13.5
Nursing	53	13.3
Production Engineering	23	5.7
Level		
100	99	24.8
200	89	22.3
300	71	17.7
400	92	23
500	34	8.5
600	15	3.7
Place of residence		
On campus	209	52.3
Off campus	191	47.7

Mean age ± SD (years): 21.3 ± 2.5.

reproductive age (15 to 49) who are married or in a union + total number of single women who are sexually active) x 100 (FP2020, 2012). The statistical measure for the analysis was the adjusted odds ratio and 95% confidence interval. The level of significance was set at $p < 0.05$ for all statistical associations. Frequency tables were used to present the results.

RESULTS

A total of 400 respondents participated in this study. The mean age of respondents was 21.3 ± 2.5, with a higher proportion 163 (40.6%) being between the age group of 21-23 years. Majority of the respondents 384 (96.0%) and 389 (97.2%) were Christians and Single respectively. A greater proportion of respondents 83 (20.8%) belonged to the Pharmacy Department (Table 1).

One hundred and sixty-one (40.2%) of the respondents were sexually active; of these, 127 (78.9%) had last sexual exposure ≤ 1 month ago. Over three-quarters of those who had sexual exposure ≤ 1 month ago 97 (76.4%) used contraceptives. Condom was the most popular form of contraceptive used by 84 (86.6%) of the

Table 2. Sexual and contraceptive history of respondents.

Variable	Frequency (N = 400)	Percent (%)
Age group (years)		
<18	19	4.7
18-20	142	35.5
21-23	163	40.7
24-26	63	15.8
>26	13	3.3
Religion		
Christian	384	96
Islam	16	4
Marital status		
Single	389	97.2
Married	6	1.5
Cohabiting	5	1.3
Department		
Pharmacy	83	20.8
Medicine	65	16.2
Plant Biology and Biotechnology	64	16
Banking and Finance	58	14.5
Soil Science	54	13.5
Nursing	53	13.3
Production engineering	23	5.7
Level		
100	99	24.8
200	89	22.3
300	71	17.7
400	92	23
500	34	8.5
600	15	3.7
Place of residence		
On campus	209	52.3
Off campus	191	47.7

*Multiple response bbillings method, birth control vaccines, basal body temperature.

respondents. A higher proportion of the respondents 61 (62.9%) got the contraceptives from their partners (Table 2). Unmet need of contraception was 18.6%. Over three-quarters of the respondents who did not use contraceptives in the past month 24 (80.0%) cited their partner's disapproval as the reason. Twelve (40.0%) and 8 (26.7%) cited fear of side effects and sexual promiscuity respectively as reasons. Four (13.3%) and 6 (6.7%) of the respondents stated personal dislike and cost of contraceptives respectively as reasons for not using contraceptives in the past 1 month (Table 3).

Older respondents were more likely to not use contraceptives in the last 1 month in both the unadjusted (OR: 1.136, CI: 0.962 to 1.340) and adjusted (OR: 1.056, CI: 0.861 to 1.296) analyses. Christian respondents were more likely to not use contraceptives in the last 1 month compared to the Muslim respondents in both the unadjusted (OR: 1.247, CI: 0.134 to 11.607) and adjusted (OR: 1.671, CI: 0.097 to 28.945). Respondents who had never married were less likely to not use contraceptives

Table 3. Reasons for contraceptive non-use in the last 1 month among respondents.

Variable*	Frequency (n = 30)	Percent (%)
Partner disapproval	24	80
Fear of side effects	12	40
Encourages sexual promiscuity	8	26.7
Reduces sexual pleasure	8	26.7
It can lead to infertility	7	23.3
Cultural beliefs	6	20
Religious beliefs	6	20
Personal dislike	4	13.3
Cost of contraceptives	2	6.7
Not easily available	1	3.3

Multiple response.

Table 4. Unadjsuted and adjusted predictors of non-use of contraceptves in the last 1 month.

Predictors	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (years)	1.136 (0.962 – 1.340)	0.132	1.056 (0.861 – 1.296)	0.602
Religion				
Christianity	1.247 (0.134 – 11.607)	0.846	1.671 (0.097 – 28.945)	0.724
Islam*	1		1	
Marital status				
Never married	0.638 (0.056 – 7.290)	0.718	0.708 (0.035 – 14.309)	0.822
Ever Married*	1		1	
On campus	1.431 (0.634 – 3.231)	0.389	1.715 (0.713 – 4.127)	0.228
Off campus*	1		1	
Level				
≤ 300	0.346 (0.150 – 0.798)	0.013	0.360 (0.129 – 1.009)	0.052
>300*	1		1	

in the past month compared to those who had ever gotten married in the unadjusted (OR: 0.638, CI: 0.056 to 7.290) and adjusted analyses (OR: 0.708, CI: 0.035 to 14.309). The level of respondents was a significant predictor of non-use of contraceptives in the past month in the unadjusted analyses, as respondents who were in ≤ 300 level were less likely not to use contraceptives in the past month compared to those who were in >300 level (p = 0.013) (Table 4).

DISCUSSION

Four in ten respondents were sexually active. This finding is similar to national studies as well as studies conducted in Africa, which show a high proportion of sexually active young persons (NARHS, 2007; NPopC and ICF Marco, 2014) Maria and Roinahn, 2015; Magreat et al., 2014). The outcomes related to sexual activity are often complex and not just health-related. In addition to exposing young persons to increased risks of STI/HIV infection, unintended pregnancy, and unsafe abortion, sexual activity also affects the social and emotional wellbeing of the individual (Vasilenko et al., 2012).

Results also show that frequency of sexual activity was high in the studied population as over three-quarters of the respondents had had sex less than a month prior to the study. Of those who had ever had sexual intercourse, majority had used contraceptives. This is in tandem with findings from a study carried out in North-East Nigeria

and Uganda in 2014 and 2016 respectively (PRB, 2016; Isa et al., 2016). Most of the sexually active respondents in this study were single and furthering their education at the time of the study; hence they were not ready to have children which they all opined so as to enable them concentrate, thus likely accounting for the finding in our study. This may imply that more individuals are making safer and more responsible sexual choices and is a step forward towards the achievement of SDGs 3 and 5. In the time frame of the SDGs, there is thus the opportunity to achieve a grand convergence between the developed and developing world, ending preventable child and maternal deaths and achieving relative parity in meeting family planning needs of persons who want to space or limit childbearing.

Condom was the most common type of contraceptives used by the respondents. This is similar to findings from studies carried out in South Western Nigeria, Southern Nigeria and Uganda in 2012, 2015 and 2016 respectively (Henry et al., 2016; Ogboghodo et al., 2017; Ajayi et al., 2016). Condoms are cheap, easily accessible and much advertised on media, which may be a reason for this finding. Condoms have been stated to have a dual role of protecting from sexually transmitted illnesses as well as preventing unwanted pregnancy; so this gives it an edge over other contraceptives and as well means that fewer people contract STIs. It is protective and preventive in the long run. Over two-fifths of respondents who used contraceptives in the past month got it from their partners. This may also be a reason why condom was the most used method of contraception in this study; however, this is a disturbing finding as the implication of this could be that more females are shying away from taking responsibility for contraception, and our cultural inclination where women take the back seat in decision making may contribute to this. Empowering women to take responsibility for contraception thereby choosing the number, timing and spacing of pregnancies is not only a matter of human rights but touches on many issues vital to sustainable development including health, education and women's status in the society.

The unmet need for contraception in this study was high (18.6%). This finding is in congruence with the results of NDHS (2013) which gave an overall unmet need of contraception of 16% NPopC and ICF Marco, 2014). A much higher value of unmet need was however observed in studies conducted in Rivers State, Nigeria (68%) and Tanzania (86%) in 2012 and 2014 respectively (Kagashe et al., 2014; Imadelo et al., 2012). Unmet need for family planning points to the gap between women's reproductive desire to avoid pregnancy and contraceptive behaviour. The sequela of unmet need for contraceptives ranges from unwanted pregnancies to maternal morbidity and mortality. This drives home the point that a lot more still needs to be done by relevant stakeholders with regards to educating females about proper and adequate uptake of contraceptives as this may be the only way to avoid unplanned pregnancies and unfortunate sequelae that could result thereof. Accessibility seems far from being a major problem to having unmet need for contraceptives especially in this highly urbanized setting; thus, corrective counseling and sensitization is a major way out in surmounting the different reasons women put forth for non-use of contraception.

Interestingly, respondents who were in their third year in the higher institution and below were more likely to use contraceptives and this was a significant finding. The results from a study carried out in Zanzibar in 2014 gave a contrast finding where female undergraduate students who started sexual activity at secondary school level were less likely to be associated with current use of contraceptives compared to those who started sexual activity in University (Sweya et al., 2016). This may be due to the fact that they are younger and less experienced sexually; hence they may shy away from risky sexual behaviours of which non-use of contraception is one, because of the fear of unwanted pregnancies. To also support this finding, with increasing age of respondents, unmet need of contraception was also found to increase in this study. This same pattern was also noticed in the NDHS (2013) where women aged 15 – 19 years had the lowest levels of unmet need of contraception (NPopC and ICF Marco, 2014).Older sexually active females are more likely to feel more experienced and hence may become more daring and more careless with regards to their sexual behavior.

The top two reasons for contraceptive non-use which in turn leads to unmet needs in this study were partner disapproval (80.0%) and fear of side effects (40.0%). This was in tandem with findings from a 51 multi country survey conducted between 2006 and 2013. Findings from Nigeria revealed fear of side effects (26.6%), personal disapproval (21.2%) and spousal disapproval (12.2%) to be the reasons for non-use mentioned by a higher proportion of women (Sedgh and Hussain, 2014). The fear of side effects cited by the respondents could be due to personal experiences, hearsay from other friends and family or perceived. However, more females need to be enlightened to know that there are other methods of contraception available if the one they had used before resulted in side effects. Partner disapproval may imply that campaigns targeted at improving uptake of contraception among women should not only be directed towards the females, but their partners as well, because an enlightened spouse or partner is more likely to support contraception. Policy and programmes intended to reduce unmet need in low- and middle-income countries, particularly efforts towards goals set for FP2020 and the Sustainable Development Goals (SDGs), should be informed by clear understanding of the causes of unmet need for family planning to better reflect the population needs and to more effectively target planning and

investments.

Conclusion

A high rate of unmet need for contraceptives was found in the course of the research and reasons such as partner's disapproval and fear of side effects were the predominant reasons for non-contraceptives use. Intensified efforts should therefore be made by health care providers to educate the public on the benefits of contraceptives and governing agencies in charge of contraceptives availability should also intensify availability and easy access of contraceptives to every individual. Individuals seeking contraceptives should be adequately counseled as well on the various types of contraceptives, their benefits and side effects so that they can make informed choice of contraceptives convenient for them. The females should also be empowered to know they have a right on their contraceptives choice and make decision to protect their reproductive health rights.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Prevalence and intensity of urinary schistosomiasis in Ogun state, Southwest, Nigeria

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Schistosomiasis is an environmentally-mediated disease that depend on the presence of suitable habitats for snails, which serve as intermediate hosts for the causative parasites. Research has shown that the disease is endemic in Osun state and remains unabated. Until now, there has never been any mapping of the disease in the State. This study will serve as a reliable baseline data for intervention planning in the State. School children were randomly selected and examined for schistosomiasis infection at Community Primary School, Eggua, Yewa North Local Government Area of Ogun State, Nigeria. Urine samples were collected in wide mouthed plastic container and were examined for schistosome eggs, using sedimentation by gravity method of the 121 pupils examined. 62 (51.2%) were tested positive for *Schistosoma haematobium* ova, the highest prevalence (53.9%) was recorded in age group 11-15 years. Also the heaviest intensity of infection (11.8%) based on the egg count per 10ml of urine was found in this age group, while 0-5 years had no infection. Males had higher infection rate (54.2%) than females (49.3%), which however was not statistically significant (P<0.05). Hence, considering the high prevalence of urinary schistosomiasis in the study community, there is a need for health education, provision of alternative sources of water, Mass Drug Administration and freshwater snail control in the area.

Key words: Urinary schistosomiasis, prevalence, intensity, eggua.

INTRODUCTION

Schistosomiasis, also known as Bilharzias, was first described in 1851 by Theodor Bilharz, after whom the disease was initially named after (WHO, 2002). It is perhaps the most important disease associated with man-made lakes and irrigation projects in tropical countries (WHO, 2013).Inadequate sanitation and contact with contaminated water bodies function in disease transmission. It is a disease caused by several species of the fluke worm of genus *Schistosoma*. The World Health Organisation (WHO identified schistosomiasis as one of the six most serious public health problems in developing countries. It affects more than 200 million persons in a

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population of 600 million in 74 countries (WHO, 2013).

Urinary Schistosomiasis is water borne trematode parasitic disease that affects 200 million people and poses a threat to 600 million in more than 76 countries including Nigeria, the disease is caused by a trematode of the genus *Schistosoma*. Among those infected, 120 million are asymptomatic and 20 million have severe clinical disease. Mortality was estimated at more than 250,000 deaths per year, making it the most deadly neglected tropical disease (NTD) (Chitsulo et al., 2002). According to the Global Burden of Disease (GBD), Schistosomiasis caused the loss of 1.7 million disability-adjusted life years (DALYs) worldwide in 2001, of which 82% (1.4 million DALYs) were from sub-Saharan Africa (SSA) alone. In 2002, WHO reported that Schistosomiasis caused one quarter of the tropical disease cluster burden (WHO, 2002).

The free swimming infective larval cercariae burrow into human skin when it comes into contact with contaminated water. The parasite is found in the venous plexus draining the urinary bladder of humans (WHO, 2013). The schistosomes are parasite of the blood stream of warm blooded vertebrates, the only digenetic trematode to occupy such habitat (The Carter Center, 2008). During infection, the parasite deposits terminal spinned eggs which clogs the venous plexus, impeding blood flow which eventually bursts the veins allowing blood and eggs to enter into urinary bladder.

Socioeconomically, Schistosomiasis is next to malaria among all water diseases and has grave public health implications (Sam-Wobo et al., 2009). The aim and objective of this study was to obtain epidemiological data on the prevalence and intensity of the infection among school children in community primary school, Eggua so that subsequent measures could be used for the control of Schistosomiasis in the study area.

A survey carried out in the South Western region of Nigeria by Ekpo and Mafiana (2004) on 192 schools in Ogun state to determine the epidemiological status of urinary Schistosomiasis in the state reveals that the overall prevalence of self-reported blood in urine and urinary Schistosomiasis were 10.00% (SD= 13.84) and 7.6% (SD= 12.85) respectively. The correlation coefficient between children's response to reported blood in urine and urinary Schistosomiasis was significantly positive ($r=0.789$. $p<0.01$). This prevalence ranges from 0.31-100.0 for the reported blood in urine and 0.81 to 100.0 for reported urinary Schistosomiasis respectively. Yewa North had the highest mean prevalence of 25.07 and 18.52% for both reported blood in urine and urinary Schistosomiasis respectively; while Ikene Local Government Area had the lowest mean prevalence 1.46% and 1.25% for both reported blood in urine and urinary Schistosomiasis respectively.

In the case of reported urinary Schistosomiasis, 674 (61.7%) schools reported infection, Yewa North had the highest number of infected schools with 82 (90.1%) and 81 (89.0%) of schools reported infection for both blood in urine and urinary Schistosomiasis respectively. Sam-Wobo et al. (2009) in a study carried out at Ibaro Oyan and Abule Titun communities revealed that four hundred and fifty respondents were examined for urinary Schistosomiasis. Using laboratory examination of urine samples and structured questionnaires, prevalence was 86.0% Ibaro Oyan and 88.0% Abule Titun. Male were more infected (89% Ibaro Oyan and 96% Abule Titun) than females (82% Ibaro Oyan and 74% Abule Titun). Report also shows that most respondents (97.4 and 99.6% respectively) from Ibaro Oyan and Abule Titun rely heavily on the Ibaro Oyan dam as their source of water and are also aware that the infection is due to their water contact practices with the dam.

MATERIALS AND METHODS

The study was carried out in Yewa North Local Government Area (L.G.A.) (formerly Egbado North) which lies between latitude 7°15N and longitudes 3°3E in a deciduous/ derived savannah zone of Ogun state. The Local Government Area has the largest land area in the state, it has a land size of 2,087 km^2. The 2006 population projection of the State Demographic indicators showed that the population size was 181,826. The major occupations of the inhabitants are farming and trading, while others are Fishermen, Artisans, Driver, Civil Servant, Bricklayers and Clergy.

Ethical approval

Full approval was given by the UI/UCH institutional ethical review committee before the commencement of the study. In addition, approval was obtained from the State Universal Basic Education Board (SUBEB) of Ogun State to carry out the research work and collect urine sample. From SUBEB, a letter was forwarded to the Education Secretary of Yewa North Local Government Education Authority from where an introduction letter was forwarded to the head teachers of the school involved, informing them of the research work and samples to be collected. The head teachers in turn informed the parents who gave their consent to their child's/children's participation in the study.

Sample collection/laboratory analysis

Urine samples were collected in wide mouthed plastic container and 10 ml aliquots was examined for schistosome eggs, using sedimentation by gravity method.

RESULTS

Out of 152 pupils enrolled for this study, only 121 urine samples were successfully collected from the pupils, age ranging from 5 to 17 (Table 1).

Prevalence of infection

Out of 121 pupils examined, 62(51.2%) were infected.

Table 1. Distribution of pupils in the study population.

Age Group (years)	Number examined	Overall percentage (%)
0-5	1	0.8
6-10	40	33.1
11-15	76	62.8
16-20	4	3.3
Total	121	100

Table 2. Prevalence of *Schistosoma haematobium* by sex in the study population.

Sex	Number examined	Number infected	Prevalence within the sex (%)
Male	48	26	54.2
Female	73	36	49.3
Total	121	62	51.2

Table 3. Prevalence of *S. haematobium* ova by age among the study population.

Age group (years)	Number screened	Number infected	Prevalence (%)
0-5	1	0.0%	0.0
6-10	40	19	47.5
11-15	76	41	53.9
16-20	4	2	50.0
Total	121	62	51.2%

Table 4. Prevalence of urinary Schistosomiasis by parents occupation in the study population.

Parents Occupation	Number examined	Number infected	Prevalence (%)
Apprentice	1	1	100
Artisan	15	7	46.7
Bricklayer	1	0	0.0
Civil Servant	12	6	50.0
Clergy	4	2	50.0
Doctor	1	0	0.0
Driver	10	4	40.0
Farming	51	27	52.9
Fishing	1	1.0	100
Photographer	1	1/0	100
Trader	24	13)	54.2
Total	121	62	51.2

Out of 62 that tested positive, 26 (41.9%) were males while 36 (58.1%) were females.

Prevalence of *S. haematobium* ova by sex at community primary School, Eggua, in Yewa North LGA

Twenty six out of 48 male students tested, were found to be infected while 36 of the 73 females in the study group were infected as shown in Table 2. Considering prevalence within the sex, prevalence in male 26 (54.2%) is higher than that of the female 36 (49.3%) with no significant difference between both sexes (p=0.601).

Prevalence of *S. haematobium* ova by age group in the study population

A total of 62 pupils were tested positive for *S. haematobium* egg. The prevalence was found to be highest among the pupils of age group 11-15 years (53.9%), followed by age group 16-20 years (50%), then 6-10 years (47.5%), lastly, 0-5 years (0%), with no significant difference among the age groups (p=0.682). This is shown in Table 3.

Prevalence of *S. haematobium* ova by occupation of the parents of subjects in the study population

Out of 62 pupils that tested positive for *S. haematobium* egg, 1 pupil with 100% prevalence has parent with fishing occupation, apprentice and photographer while pupils with parents that are clergy and civil servants were just 2 and 6 respectively, with prevalence of 50%. Pupils with parents that are farmers were the most infected group 27 (43.5%) with prevalence of 52.9%, pupils with parents that are traders are 54.2% (13) and pupils with parents that are Drivers have the lowest prevalence 40% (4). This is shown in Table 4.

Intensity of urinary Schistosomiasis by age group in the study population

Table 5 shows the intensity of urinary Schistosomiasis across age groups. It shows that the intensity ranges from light to heavy based on the number of egg count. Age group 11 to 15 (11.8%) shows highest level of heavy intensity, follow by 6 to 10 (5.0%); other age groups show none. Moderate intensity of infection was detected in all age group except in age group 0 to 5. Light intensity was also detected only in age group 6 to 10 and 11 to15.

Intensity of *S. haematobium* infection in relation to sex based on number of egg count in the study population

Table 6 shows that light to moderate and heavy intensity

Table 5. intensity of *S. haematobium* infection in relation to Age Group Based on the no. of egg count in the study population.

Age (years)	Number examined	Number infected	Light intensity	Moderate intensity	Heavy intensity
0-5	1	0	-	-	-
6-10	40	19	10	7	2
11-15	76)	41	21	11	9
16-20	4	2	-	2	-
Total	121	62	31	20	11

Key: light (1-9 eggs/10 ml urine), moderate (10-49 eggs/10 ml urine), heavy (≥50 eggs/10 ml urine) intensity.

Table 6. Intensity of *S. haematobium* infection in relation to sex based on no. of egg count in the study population.

Age (years)	Number examined	Number infected	Light intensity	Moderate intensity	Heavy intensity
Male	48	26	15	9	2
Female	73	36	16	11	9
Total	121	62	31	20	11

Key: light (1-9 eggs/10 ml urine), moderate (10-49 eggs/10 ml urine), heavy (≥50 eggs/10 ml urine) intensity.

of infection occurred in the study population, with females (36) having higher severity of infection at all level than males (26).

Factors associated with prevalence of *S. haematobium*

All factors or variables (age, sex of the subject and occupation of the parent) associated with the prevalence of infection were entered into multiple regression model (using the same software). There is correlation between all these variables. Age of the subject has the highest beta coefficient (0.072).

DISCUSSION

The prevalence of urinary Schistosomiasis found in this study (52.1%) is higher than the one reported by Ekpo and Mafiana (2004), (18.52%), when they reported that Yewa North has the highest prevalence level of 57.1% found among school children in Ijoun community in Yewa North Local Government (Oso, 2010).

More females (58.1%) were infected than male (41.9%), and this may be due to higher number of females that were in the study population. Prevalence of infection is higher in male than in female, with no statistical significant difference (x^2=0.601, p<0.05). This is also the same with some reported cases of higher prevalence of infection in male in some endemic areas (Oladejo and Ofoezie, 2006; Ugbomoiko, et al., 2010). As noted by Ugbomoiko et al. (2010), the apparent male bias in prevalence rate may be due to the predominantly male participation in farming contaminated water which aids or facilitate the transmission of the disease. These practices are very common in the study area because of the level of the civilization and availability of portable water. Streams in the study area are the only source of water. Also, males have more contact with these streams because female pupils like those in primary 5 and 6 always try to prove their maturity and refuse to participate in the recreation activities after the school hour but they still wade through the streams while going home, farm or bath in them early in the morning before going to school. Males through their vigorous activities and act of playfulness are always bathing and swimming for fun.

Urinary Schistosomiasis is one of the most endemic diseases in Nigeria. The prevalence of this disease, like many other endemic diseases, is affected by socio-cultural characteristics of the area; hence the obvious difference in the distribution of the disease in different parts of the country Gryseels,2006 ;Oladejo et al 2011a; Oladejo and Ofoezie, 2006; Ugbomoiko et al., 2010). Even within the same geographical area, such differences are bound to exist between the different age groups.

The highest prevalence (53.9%) observed in the age group 11 to15 shows that this age group has a high exposure rate and this is similar to the reports of other previous studies from other previous studies from other parts of the country (Ogbonna and Okoronko, 2000; Oladejo and Ofoezie, 2006; Ugbomoiko et al., 2010). This is followed by pupils in age group 16 to 20.

Considering the occupation of the subjects' parents, this study revealed that pupils whose parents are farmers were most infected (27, 43.5%); and this may be due to

the frequent contact of the pupils with the stream while going to farms with their parents. It then means that parent occupation is also an important factor to be considered when study is carried out on this infection in any part of the country. For instance, the highest heavy intensity was found in pupils whose parents were farmers; which may be attributed to increase in worm burden and high fecundity rate of the parasite.

Heavy intensity of infection was higher in females (9) than in males (2); this may be due to the fact that more females were involved in the study or that females were mostly involved in those activities known to favor infection as a result of their gender assigned responsibilities.

Conclusion

It is suggested that any program of urinary Schistosomiasis control in Yewa North should include the present study area. Such control program should include provision of good and reliable sources of water for these communities, as this has constituted a lot of damages to the communities. Besides the closest and available water source happened to be infected, the people have no choice rather than to go for such, expect for the health conscious inhabitants which are very few. There was a high prevalence of urinary schistosomiasis in the study communities. There is a need for health education, provision of alternative sources of water, Mass Drug Administration and freshwater snail control in the study communities.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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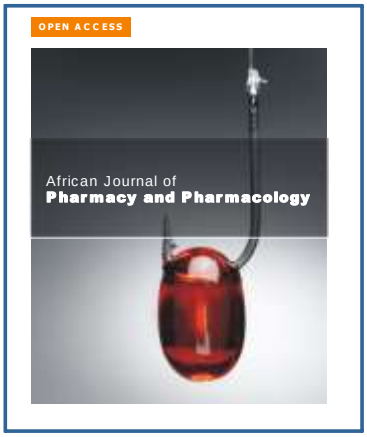

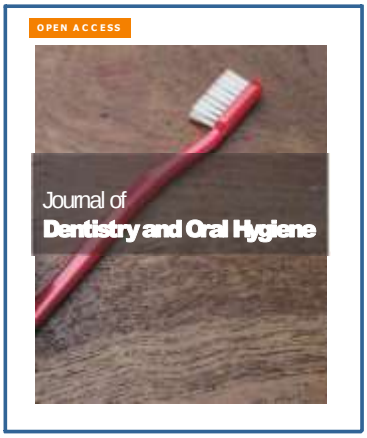

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