Knowledge, attitude and practice of antibiotic use among residents of a community in South-West Nigeria

Abdulhakeem O. Abiola[1], Esther O. Oluwole[1], Omotola A. Oredipe[1], Aisha T. Abdulkareem[2]

[1]Department of Community Health and Primary Care, College of Medicine, University of Lagos, Nigeria
[2]Department of Community Health and Primary Care, Lagos University Teaching Hospital

Corresponding author: Esther O. Oluwole
Email address: oluester2005@yahoo.com; Phone: +234 803 567 3029

ABSTRACT

Background: The rapid increase in the rate of antibiotic-resistant pathogens hasbecome a global concern of public health interest in recent decades. Most antibiotic-resistant pathogens are community-acquired and as such the World Health Organization has appealed to member states to create policies on and educate the public about antibiotic resistance and the community's role in its development.

Objectives: This study assessed the knowledge, attitude and practice of antibiotic use among residents of Ikeja Local Government Area, Lagos, Nigeria.

Methods: A cross-sectional descriptive study was conducted among 306 adult residents selected through multistage sampling technique. Data were collected using an interviewer-administered structured questionnaire and analyzed with Epi info version 7.1 software. Chi-square was used to test association with level of significance set at $p \leq 0.05$.

Results: The age range of respondents was 18-78 years with a mean±Sd of 32.7±11.4 years Most of the respondents (71.2%) had good knowledge about antibioticsin this study.About 29.0% of the respondents believed that there is no need to complete the course of antibiotic treatment if they already feel better while almost half (46.7%) of the respondents had used antibiotic without a doctor's prescription in the twelve months preceding the study and a little less than half (42.8%) of the respondents felt they should start an antibiotic on their own if they have cough for more than a week.

Conclusion: Majority of the participants had good knowledge of antibiotics but a wide gap exists in their attitude towards and practice of antibiotic use. Hence, there is need for a stricter regulation towards the purchase of antibiotics without a prescription in Nigeria.

Keywords: Antibiotic Use, Knowledge, Attitude, Practice, Self-Medication, Community

Connaissance, attitude et pratique de l'usage d'antibiotiques parmi les résidents d'une communauté du sud-ouest du Nigeria

Abdulhakeem O. Abiola[1], Esther O. Oluwole[1], Omotola A. Oredipe[1], Aisha T. Abdulkareem[2]

[1]Département de santé communautaire et de soins primaires, Collège de médecine, Université de Lagos, Nigéria
[2]Département de santé communautaire et de soins primaires, Centre hospitalier universitaire de Lagos

Contributeur correspondant :Esther O. Oluwole
Email address: oluester2005@yahoo.com; Téléphone: +234 803 567 3029

RESUME

Contexte: L'augmentation rapide du taux de pathogènes résistants aux antibiotiques est devenue une préoccupation mondiale intéressant la santé publique au cours des dernières décennies. La plupart des agents pathogènes résistants aux antibiotiques sont d'origine communautaire et, à ce titre, l'Organisation mondiale de la santé a appelé les États membres à élaborer des politiques et à informer le public sur la résistance aux antibiotiques et le rôle de la communauté dans son développement.

Objectifs: Cette étude a évalué les connaissances, l'attitude et la pratique de l'utilisation d'antibiotiques chez les résidents dudistrict d'Ikeja(Ikeja Local Government Area), à Lagos, au Nigéria.

Méthodes: Une étude descriptive transversale a été menée auprès de 306 résidents adultes sélectionnés au moyen d'une technique d'échantillonnage en plusieurs étapes. Les données ont été recueillies à l'aide d'un questionnaire structuré administré par l'intervieweur et analysées avec le logiciel Epi info version 7.1. Le Chi-carré a été utilisé pour tester l'association avec le niveau de signification fixé à p≤0,05.

Résultats: La tranche d'âge des répondants était de 18 à 78 ans avec une moyenne ± Sd de 32,7±11,4 ans. La plupart des répondants (71,2%) avaient une bonne connaissance des antibiotiques dans cette étude. Environ 29,0% des répondants pensent qu'il n'est pas nécessaire de terminer le traitement antibiotique s'ils se sentent déjà mieux alors que près de la moitié (46,7%) des répondants avaient utilisé des antibiotiques sans ordonnance d'un médecin au cours des douze mois précédant l'étude et un peu moins de la moitié (42,8%) des répondants estiment qu'ils devraient commencer un antibiotique par eux-mêmes s'ils toussent depuis plus d'une semaine.

Conclusion: La majorité des participants avaient une bonne connaissance des antibiotiques, mais il existe un grand écart dans leur attitude vers et la pratique de l'usage des antibiotiques. Par conséquent, il faut une réglementation plus stricte pour l'achat d'antibiotiques sans ordonnance au Nigéria.

Mots-clés: utilisation d'antibiotiques, connaissances, attitude, pratique, automédication, communauté

INTRODUCTION

Antibiotics are chemical substances which kill or inhibit the growth of bacterial organisms and are used in the prevention and treatment of infectious diseases.[1] The term antibiotic originally meant a chemical substance produced by microorganisms which is effective in destroying bacteria or stopping their growth. The definition of antibiotics has been expanded to include synthetic and semi-synthetic chemical substances which have similar capabilities.[2]

Antibiotic resistance occurs when antibiotics lose their ability to kill or inhibit the growth of bacterial organisms and thus, these bacteria continue to multiply even when antibiotics are used at therapeutic levels. Antibiotic resistance is a natural phenomenon and will occur without human actions because of the genetic evolution most bacteria undergo. However, the alarmingly high levels of antibiotic resistance in the world today is largely attributed to human activities such as antibiotic misuse/overuse and a reduction in the development of new antibiotics.[3] There is no country in the world that is not affected by antibiotic resistance.[4,5]

Some common types of human behavior also play a role in promoting resistance. Influence of human activities causesinterruption and changes in natural ecosystem which in turn leads to increase in the resistance of human pathogens. Some contributing factors to increasing multi drug resistance can be attributed to overuse and mis-use of antibiotics. In addition, poor hygiene and poor or lack of control measures for infection prevention and control, has also contributed in a measurable way to the proliferation and rapid spread of resistant strains. Most drug resistant strains are seen in the hospitals where most of the drugs are prescribed.[6-8]

In developing countries, factors such as overcrowding, lack of portable water and poor sanitation have been associated with higher antimicrobial resistant. Similarly, bacteria resistant can occur as a result of the contamination of water by hospital effluents and livestock farms. In Agricultural sector, recycled sewage sludge has been known to contain lots of enteric bacteria resistant strains. Nowadays, the food preservatives in use, acts by increasing the lag phase of bacteria to decrease or inhibit bacterial growth but at the same time making these bacteria more resistant by increasing their genetic and phenotypic adaptations, which in turn increases the genetic diversity and the chances of survival for the pathogens. Similarly, farm manure from animal, has been known to contain antibiotics. When bacteria get expose to these antibiotic residues, they finally become resistant with higher probability of transferring the antibiotic resistant genes.[9-11]

Other human factors contributing to antibiotics resistance includes patient self-medication and noncompliance with recommended treatments. It has been reported that in some countries, problems of noncompliance and self-medication are exaggerated because large number of the available antimicrobials are poorly manufactured, fake, or have exceeded their expire dates.[12]

Antibiotic resistance leads to prolonged hospital admissions, increased need for more expensive and in many cases, more toxic antibiotics and an overall increase in the financial costs of healthcare. It also poses a threat to medical innovations such as chemotherapy, organ transplants and other surgical procedures, and has contributed significantly to mortality due to infectious diseases.[5]

Each year, in the United States (US), about two million people become infected with bacteria that are resistant to at least one of the antibiotics used to treat them and as such antimicrobial resistance has serious cost implications on the US healthcare system.[13] Results of a study sponsored by the Alliance for the Prudent Use of Antibiotics showed that antibiotic-resistant infections cost U.S. hospitals more than 20 billion dollars per year.[14] According to the European Center for Disease Prevention and Control, 25,000 lives are lost every year as a result of infection with multi-drug resistant bacteria such as methicillin resistance*Staphylococcus aureus*(MRSA). These multi-drug resistant bacterial infections also account for increase medical costs and loss of productivity of up to 1 billion euros per year.[15]

Antibiotic resistance is a much bigger problem in developing countries. In 2010, the Chinese Ministry of Health (MOH) National Antimicrobial Resistance Investigation Net (Mohnarin) reported that the prevalence of extended-spectrum beta-lactamase-producing *Escherichia coli* was 71.2% and that of methicillin-resistant *Staphylococcus aureus* was 50.5%.[16] A WHO report published in April, 2014 stated that the levels of antibiotic resistance in the WHO Eastern Mediterranean region were very high. In the region, there are high levels of resistance of *Escherichia coli* to third-generation cephalosporins and fluoroquinolones. In some parts of the region, majority of the *Staphylococcus aureus* infections are methicillin-

resistant.[17]

The African continent is also plagued by alarming levels of antibiotic resistance.[18] Antibiotic resistance, is of particular concern in sub-Saharan Africa where poverty is prevalent and the burden of infectious diseases is high, because unlike in developed countries, second-line and third-line antibiotics are not readily available and in most cases, when they are available, they are expensive.[19] There have been reports of Methicillin-resistant *Staphylococcus aureus* in South-East Nigeria,[20] and of high-speed evolution of fluoroquinolone-resistant *Escherichia Coli* in Nigeria.[21]

Most antibiotic-resistant pathogens are community-acquired[22] and as such the World Health Organization (WHO) has appealed to member states to create policies and educate the public about antibiotic resistance and the community's role in its development.[5] This study assessed the knowledge of antibiotics, attitudes towards antibiotic use and current practices of antibiotic use among the participants.

METHODS

This study was carried out between August and September, 2017 among residents of Ikeja Local Government Area, Lagos State, Nigeria. A minimum sample size of 264 was obtained using Cochran's formula $(n=z^2pq/d^2)$ with the level of significance set at 5% and prevalence of 22% self-medication with antibiotics from a previous study conducted in Nigeria.[23] However, 306 participants were enrolled in the study using the multi-stage sampling method. Three out of six wards in Ikeja Local Government Area were selected by simple random sampling (balloting without replacement). The streets used were also selected using the same method. All houses on each street were selected until the sample size was achieved. The households and respondents from each household were selected using simple random sampling. A pre-tested interviewer-administered questionnaire was used to obtain information about the sociodemographic characteristics, knowledge about antibiotics, attitudes towards antibiotic use and practice of antibiotic use among the respondents, after an informed consent had been obtained.

The questions assessing knowledge were scored as either correct or incorrect. Every correct option was given a score of 1 mark, every incorrect response and non-response was given a score of 0. The highest possible knowledge score was 17. Respondents with scores from 0 to 8 were graded as having poor knowledge and those with scores between 9 and 17 were graded as having good knowledge about antibiotics. Statistical analysis was performed with Epi info version 7.1 software. Chi-square was used to test association with level of significance set at $p \leq 0.05$.

All statistical significance was considered with probability that $p < 0.05$. Variables (age, gender, education level, ethnicity and employment) were expressed using descriptive statistics such as frequencies (n) and percentages (%). Chi-square test ($\chi 2$) was used to determine if an association exists between proportions of two or more groups.

Ethical considerations

Ethical approval was obtained from Lagos University Teaching Hospital Health Research and Ethics Committee (Ref no: ADM/DCST/HREC/APP/077) while informed consent was obtained from the respondents prior to data collection.

RESULTS

A total of 306 questionnaires were administered, retrieved and analyzed, giving a response rate of 100%. The age range and mean±sd of the respondents were 18-78 years and 32.7±11.4 years respectively. There were more female (55.2%) than male (44.8%) respondents in this study. Majority (77.5%) of the respondents had tertiary education while 72.2% of the respondents were from Yoruba ethnic group. Majority (90.2%) of the respondents had no experience of work or study in medical field. (Table 1)

Table 1: Sociodemographic characteristics of the respondents

| Variables	Frequency (n=306)	Percentage (%)
Age (years)		
18-28	135	44.1
29-38	85	27.8
39-48	48	15.7
49-58	30	9.8
59-68	6	2.0
69-78	2	0.7
Mean + SD = 32.74+ 11.40		
Gender		
Male	138	44.8
Female	168	55.2
Level of education		
No formal education	6	1.9
Primary	5	1.6
Secondary	58	19.0
Tertiary	237	77.5
Marital status		
Married	135	44.1
Single	162	52.9
Divorced	1	0.33
Separated	2	0.7
Widowed	6	2.0
Ethnicity		
Hausa/Fulani	6	1.9
Igbo	32	10.5
Yoruba	221	72.2
Others	47	15.4
Occupation		
Skilled	165	53.9
Semi-skilled	34	11.1
Unemployed	83	27.1
Unskilled	24	7.9
Work or Study in medical field		
Yes	30	9.8
No	276	90.2

Majority (91.5%) of the respondents knew that antibiotics are medicines used to kill bacteria, however, less than half (44.1%) of the respondents believed that antibiotics can cure all infections and 27.1% of the respondents thought that antibiotics are used to relieve body pain. More than half (55.8%) of the respondents knew that antibiotics can destroy the body's normal flora while about 57.5% of the respondents correctly identified penicillin as an antibiotic. About half (53.9%) of the respondents believed that resistance to antibiotics is a worldwide problem. Overall, most (71.2%) of the respondents had good knowledge about antibiotics and its use. (Table 2 & Fig.1)

Table 2: Antibiotics action and use, identification and side effects

Variable Antibiotics Action and Use	True	False	Don't Know
Antibiotics are medicines that kill bacteria	280(91.5%)	10(3.3%)	16 (5.2%)
Antibiotics can be used to treat all coughs and colds	148(48.4%)	90(29.4%)	68(22.2%)
Antibiotics can cure all infections	135(44.1%)	110(39.9%)	61(19.9%)
Different antibiotics cure different diseases	230(75.1%)	39(12.8%)	37(12.1%)
Antibiotics are used to relieve body pain	83(27.1%)	171(55.8%)	52(16.9%)
Antibiotics are used to stop fever	109(35.6%)	124(40.5%)	73(23.8%)
Antibiotics can kill good bacteria in the body Antibiotics Identification	171(55.8%)	68 (22.2%)	67(21.9%)
Paracetamol	57(18.6%)	205(66.9%)	44(14.3%)
Penicillin	176(57.5%)	75(24.5%)	55(17.9%)
Chloroquine	90(29.4%)	136(44.4%)	80(26.1%)
Artesunate	97(31.7%)	132(43.1%)	77(25.16%)
Side Effects of Antibiotics Antibiotics do not have side effects	65(21.24%)	183(59.80%)	58(18.95%)
Antibiotic can cause allergic reactions	199(65.0%)	39(12.7%)	68(22.22%)
If an antibiotic causes reaction on your skin, you should not use it again Antibiotics Resistance	219(71.57%)	43(14.05%)	44(14.38%)
The unnecessary use of antibiotics can increase the resistance of bacteria to them	185 (60.5%)	44 (14.4%)	77 (25.2%)
Resistance of antibiotics is a worldwide problem	165 (53.9%)	41 (13.4%)	100 (32.7)
Humans can be resistant to antibiotics	189 (61.8%)	32 (10.5%)	85 (27.8%)

Overall Knowledge of respondents

28.80%

71.20%

■ **Good**   ■ **Poor**
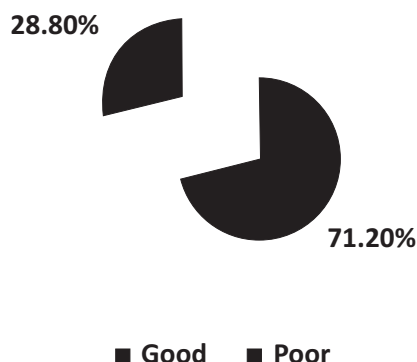
Figure 1: Overall knowledge of respondents towards antibiotics and its use.

Almost all (92.8%) of the participants agreed that it is necessary to look at the expiry date before buying an antibiotic while majority (78.8%) of the respondents did not believe it was good to obtain antibiotics from relatives and friends without having to see a medical doctor. Only a few 88 (28.8%) of the respondents believed that there was no need to complete the course of antibiotic treatment if they already feel better.

However, some 76 (24.8%) of the participants felt they should be able to buy antibiotics from a pharmacy without a prescription while almost half (42.8%) of the respondents believed that they should start using an antibiotic if they have cough for more than one week and as many as 30.7% of the respondents felt there was a need to keep antibiotics at home for emergencies despite their level of knowledge. (Table 3).

Table 3: Attitude of the respondents towards antibiotic use

Variable	Agree	Undecided	Disagree
I feel there is no need to complete the course of antibiotic treatment if I already feel better	88(28.8%)	30(9.8%)	188(61.4%)
I think it is necessary to look at the expiry date of an antibiotic before using it	284(92.8%)	14(4.6%)	8(2.6%)
It is good to be able to get antibiotics from relatives and friends without having to see a medical doctor	36(11.7%)	29(9.5%)	241(78.8%)
I think I should be able to buy antibiotics from a pharmacy without a prescription	76(24.8%)	46(15.0%)	184(60.1%)
I feel there is no need to keep antibiotics at home for emergencies	94(30.7%)	53(17.3%)	159(51.9%)
I feel I should start an antibiotic if I have cough for more than a week	131(42.8%)	64(20.9%)	111(36.3%)
When I have a sore throat, I feel I have to use an antibiotic	156(50.9)	56(18.3%)	94(30.7%)

More than half (58.2%) of the respondents had been prescribed an antibiotic for one reason or the other in the twelve months preceding the study. One hundred and eighty-six (60.8%) of the participants said they used their last course of antibiotics as prescribed. For those

respondents who did not finish the last course of antibiotics, the commonest reasons given includes not wanting their body to get 'used' to the antibiotic (45.8%), frequently forgetting to take doses (45.1%), unpleasant side effects (40.3%) and a belief that antibiotics should be

stopped as soon as one starts feeling better (38.9%). Almosthalf (46.7%) of the respondents had used an antibiotic without a doctor's prescription in the twelve months preceding the study. The major conditions for which antibiotics were used without a prescription were cough (29.7%), malaria (29.0%), sore throat (29.4%) and genital tract infections (24.8%). Statistically significant association was found between knowledge and gender of the respondents. (p<0.05) (Table 4 & 5)

Table 4: Practice of antibiotic use among respondents

Variable	Frequency	Percentage (%)
Been prescribed an antibiotic in the last twelve months	178	58.2
Finished last antibiotic course the way it was prescribed	186	60.8
Reason for not finishing prescribed antibiotic course		
Could not take antibiotics because of work, child care or social constraints	38	26.2
Frequently forgot to take doses	65	45.1
Believe it makes sense to stop taking antibiotics as soon as you start getting better	56	38.9
Did not want your body to get 'used' to the antibiotic	66	45.8
You believe antibiotics are 'unnatural'	49	34.0
Side effects of the antibiotics made you feel unwell	58	40.3
Deliberately stopped antibiotic use early so you can have antibiotics to use in future to avoid the challenges of consultation and obtaining new antibiotics from a doctor	45	31.3
Used an antibiotic without a doctor or dentist's prescription in the past twelve months	143	46.7
No of times you used an antibiotic without a prescription in the past year		
None	98	32.0
Once	89	29.0
Twice	52	16.9
Three times	22	7.1
More than three times	45	14.7
Conditions for which antibiotics were used without a prescription		
Common cold	38	12.4
Cough	91	29.7
Malaria	89	29.0
Body pain	60	19.6
Sore throat	90	29.4

Table 5: Association betweensociodemographic variables and knowledge of respondents

Variables	Poor knowledge	Good knowledge	Total	Test statistics
Age group				$X^2 = 0.644$
18-37	61 (28.5%)	153 (71.5%)	214 (100.0)	df = 2
38-57	23 (28.0%)	59 (72.0%)	82(100.0%)	P = 0.725
58 and above	4 (40.0%)	6 (60.0%)	10 (100.0%)	
Gender				$X^2 = 7.250$
Female	38 (22.5%)	131 (77.5%)	169 (100.0%)	df = 1
Male	50 (36.5%)	87 (63.5%)	137 (100.0%)	P = **0.007**
Level of education				
None	3(50.0%)	3(50.0%)	6(100.0%)	
Primary	0 (0.0%)	5 (100.0%)	5 (100.0%)	$X^2 = 3.647$
Secondary	15 (25.9%)	43 (74.1%)	58 (100.0%)	df = 3
Tertiary	70 (29.5%)	167 (70.5%)	237 (100.0%)	P = 0.302
Marital status				
Divorced	0 (0.0%)	1 (100.0%)	1 (100.0%)	
Married	35 (25.9%)	100 (74.1%)	135 (100.0%)	$X^2 = 2.387$
Separated	1 (50.0%)	1 (50.0%)	2 (100.0%)	df = 4
Single	51 (31.5%)	111 (68.5%)	162 (100.0%)	P = 0.665
Widowed	221(16.7%)	5 (83.3%)	6 (100.0%)	
Ethnicity				
Hausa/Fulani	2(33.3%)	4 (66.7%)	6 (100.0%)	
Igbo	12 (37.5%)	20 (62.5%)	32 (100.0%)	$X^2 =1.547$
Yoruba	62 (28.1%)	159 (71.9%)	221 (100.0%)	df = 3
Others	12 (25.5%)	35 (74.5%)	47 (100.0%)	P = 0.671

DISCUSSION

This study revealed that 44.1% of the respondents were between ages 18 and 28 years which is comparable to findings of a study done in Kuwait where 44.9% of the respondents were between ages 21 and 29.[24] There were more female (55.2%) than male respondents (44.8%) in this study. This finding is similar to that of a study conducted in Jos, Nigeria which reported more female (63.8%) than male respondents (36.3%).[16] More than half of the respondents (59.8%; n=183) had good knowledge about antibiotics which may be attributable to the fact that majority (77.5%, n = 237) of the respondents in this study had tertiary education.

The areas of concerns in this study include the fact that about 35.6% of the respondents wrongly agreed that antibiotics are used to cure fever, this finding is similar to the finding of a Ugandan study where 35.7% of the respondents agreed that antibiotics are used to decrease fever.[25] Similarly, it is worthy of note that about 76 (24.8%) of the respondents in this study felt they should be able to get antibiotics from a pharmacy without a prescription, which is in contrast to findings of a study conducted in Kuwaiti where only few 6.3% of the respondents had the same attitude.[24] This may be due to the uncontrolled access to purchase of antibiotics without prescriptions in Nigeria. Also, about 131 (42.8%) of the respondents agreed to the statement that "they would start an antibiotic if they had cough for more than one week" which is similar to the finding of a similar study in Kuwaiti where 35.0% of the respondents agreed to the same statement.[24] This may be attributed to the ease of obtaining antibiotics without a prescription and the belief of most people that antibiotics cure all types of cough.

Surprisingly, majority (92.8 %) of the respondents agreed at looking at the expiry dates of antibiotics before using them. This finding is similar to that of a study on Antibiotic Use in Some Nigerian Communities which reported that respondents demonstrated positive attitudes in looking at the expiry dates of antibiotics before using them (93.3%).[23] Of much concern is the practice of respondents towards the use of antibiotics as

almost half (46.7%) of the respondents in this study had obtained antibiotics without a doctor's prescription in the twelve months preceding the study. This finding however, is higher to that of the study in Kuwait and Namibia where only 27.5% and 15% of the respondents respectively had obtained antibiotics without a doctor's prescription in the twelve months preceding the study.[24,26] A similar study in Nigeria also reported that "Self-medication with antibiotics is highly prevalent in Northwest Nigeria, with most medicines being purchased from un-licensed stores without prescription from a physician."[27] This finding may be attributed to weakness of laws guarding the restrictions as regards purchase of antibiotics without a prescription despite the fact that antibiotics are classified as prescription-only medications in Nigeria.[28]

About 199 (65.0%) of the respondents in the present study agreed that antibiotics can cause allergic reactions which is similar to findings of studies in Indonesia(70.0%) and Jordan(69.6%).[29-30] About 185 (60.5%) of the respondents agreed that unnecessary use of antibiotics will cause an increase in antibiotic resistance. This finding however, is lower compared to the finding of a similar studies in Nigerian and Uganda where 75.8% and 72.0% of the respondents respectively agreed to a similar statement.[24-25] Similarly, a study on public knowledge, attitudes and behaviour towards antibiotic usage in Windhoek, Namibia reported that Seventy-two percent (72%) of the respondents understood that unnecessary use of antibiotics makes them ineffective.[26]

Majority (92.8%) of the respondents in this study agreed that it was necessary to check the expiry date of antibiotics before using them which is in keeping with the finding of a study conducted in Jos, Nigeria where 93.3% of the respondents agreed to same statement.[23] This is commendable and may be as a result of efforts of the National Agency for Food and Drug Administration and Control (NAFDAC) in increasing the public's awareness of drug safety.[31]The common conditions for which respondents in this study used antibiotics without a prescription were cough, sore throat, malaria and genital infections. A similar study in Nigeria reported that "the most common negative attitudes demonstrated by respondents were their expectation to be prescribed an antibiotic for cold (66.3 %) and taking an antibiotic when they have cold to get better quickly (60.9 %)"[28] This reveals poor understanding of the respondents about the causes of different infections and uses of antibiotics which may also be due to the fact there are no translations in Nigerian local dialects for words like

'bacteria' and 'virus'. Respondents' good knowledge of antibiotics and its use was found to be significantly associated with gender (p<0.05). Female respondents in this study had better knowledge of antibiotics compared to the male respondents. This finding is contrary to a similar study in India where KAP scores were found to be higher for males.[32] This was a cross sectional study therefore, interpretations are limited. Also, responses to questions may be subject to recall bias. Despite all, the findings form a base line for the knowledge, attitude and practice of antibiotic use among community residents in Nigeria.

CONCLUSION

Majority of the respondents in this study had good knowledge of antibiotic use. Most of them had finished their antibiotics courses as prescribed, however, almost half had used antibiotics without a prescription in the last twelve months. This finding revealed a wide gap in the attitude and practice of respondents towards antibiotic use. Hence, the use of social marketing strategies by government in conjunction with health workers to increase awareness and improve positive attitude and practice of about antibiotic is recommended. Moreover, there is need for proper regulation by government officials on the sale of antibiotics by pharmaceutical stores alongside professional education for the pharmacists and other health workers.

ACKNOWLEDGEMENT

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