Afr. J. Med. med. Sci. (2005) 34, 251-258

Factors associated with malaria treatment failures in Ibadan

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Summary
This study aims to find out factors associated with anti-malarial drug resistance in some selected areas in Ibadan. One thousand one hundred and two subjects were interviewed using a semi structured questionnaire. Respondents were put into two groups (high and low resistant areas). The Results revealed a high level of drug use for treating malaria particularly choloroquine and sulfadoxine-pyrimethamine ("Fansidar"). The Results also showed that the two groups were not significantly different with respect to clearance of infection, but there was a significant difference between clearance of infection and whether or not the respondent completed the course of treatment in each group ($P<0.05$). When both groups were combined, the Mantel-Haenszel test showed that the response difference between the two groups was significant. (OR = 3.44 (CI = 1.8 to 6.51)) i.e those that completed the treatment were 3 times more likely to have their infection cleared than those that did not complete the treatment. A significant finding was that non-compliance with treatment was a major factor associated with treatment failure. The prevalence of drug resistance was a little higher in the high resistant group compared to the low resistant group; but this difference was not statistically significant. These results underscore the need for adequate health education about the treatment of malaria and the importance of compliance in this community.

Keywords: *Treatment failures, malaria, compliance, Ibadan*

Résumé
Cette étude vise a trouver des facteurs lies a la resistance des medicaments antipaludeens dans quelques regions selectionnees a Ibadan. z la dans quelques-uns a sélectionné des régions dans Ibadan. 1,102 personnes ont été interrogées en utilisant une questionnaire semi-structurer. Les personnes interrogées ont été mis en deux groupes (région de forte et faible résistance). Les résultats ont montre un niveau d'usage éleve de médicament pour traiter le paludisme, particulièrement avec la chloroquine et le sulfoxine-pyrimethamine (fansidar). Les résultas ont aussi montre que les deux groupes n'étaient pas assez différent en ce qui concerne la purgation d'infection, mais il y'avait une différence claire entre la purgation d'infection et le fait que la personne interrogée ait complété oui ou non le cours du traitement dans chaque groupe (p<0,05). Quand les deux groupes ont été combines, le test de Mantel-Haenszel a montre que la différence de réponse entre les deux groupes était (OR=3,44 (CI= 1,8 a 6,51) c'est-à-dire que, ceux qui ont complété le traitement étaient 3 fois plus sur d'avoir leur infection purgée que ceux qui n'ont pas complété le traitement. Une importante découverte étaient que le non-respect du traitement était un facteur majeur lie à l'échec du traitement. La fréquence de résistance au médicament était un peu plue élevé dans le groupe a résistance forte compare au groupe de résistance faible, mais cette différence n'était pas statistiquement considérable. Ces résultats font ressortir les besoins d'une éducation sanitaire adéquate en matière de traitement du paludisme et l'importance de s'y conformer dans cette communauté

Introduction

Malaria is an important cause of morbidity and mortality in much of the developing world [1]. Specifically, malaria is identified as the most prevalent type of infective and parasitic disease [2]. The disease consistently ranks among the foremost common causes of death for all ages and represents 8-12% of child- hood deaths of under-fives. Estimates indicate that approximately 50% of the population experience at least one episode of malaria each year.

The problem of malaria in Nigeria is complicated by the existence of drug-resistant malaria whose prevalence has increased from barely 20% in the late 1970s when it first became noticeable to about 40% in 1998 [3]. The existence of chloroquine-resistant *Plasmodium falciparum* in Southwestern Nigeria has been demonstrated [4]. Up to 10% diminishing sensitivity of the parasite, *in-vivo*, to sulfadoxine-pyrimethamine (the second line oral antimalarial drug) has also been documented in some parts of the Southwest [5]. Resistance is the ability of the parasite to multiply or to survive in the presence of concentrations of a drug that normally destroy parasites of the same species or prevent their multiplication.

Prompt access to effective antimalarial treatment is a major strategy for reducing the intolerable burden of malaria in Africa where many children die before they reach health facilities [6]. A major obstacle to the effective implementation of this strategy is presented by the often low attendance rates at health centres caused by the physical difficulty in reaching the health centre, the scarcity of affordable drugs and the poor performance of health per-

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sonnel [7]. In these instances, many people seek to resolve their health problems at the household level without recourse to formally trained health professionals, particularly for disease episodes they perceive as mild. Evidence on compliance with antimalarial chemo-prophylaxis has demonstrated that those noncompliant with their medication have a 2-4 fold increased risk of infection [8,9,10,11].

Database of patient profile from the clinical studies of the drug resistant network at the Adeoyo Hospital Ibadan, Nigeria revealed geographic distribution of resistant parasite strains and treatment failure with standard first line drug (chloroquine) in seven communities in the city of Ibadan [12]. The communities are Orita Aperin, Ogere, Aremo, Atipe Oke Ofa, Oranyan, Oke Are and Agbeni.

As part of the new rethinking in Africa, which focuses on the influence of the social, cultural and behavioural responses to malaria control, on the emergence of resistance to antimalaria drugs, this study will provide descriptive information on community illness perception and recognition, prevention and treatment practices, sources where treatment is sought, medication knowledge, pattern of antimalarial drug use and extent of compliance with standard treatment guidelines. This information will be used to determine factors influencing the development of resistance and for assessing the appropriateness of treatment sought.

Materials and methods

Study sites: The study took place between April and July 2002 in Ibadan. Ibadan is the largest city in Africa south of the Sahara. It is located on latitude 7° 22 N of equator and longitude 30 58E. It is 235.2 meters (784 feet) above sea level. The climate is that of tropical rain forest zone, with a warm dry-season from November to March, a rainy season from April until October and a cold, dry and dusty harmanttan season in December and January. Ibadan belongs to the holoendemic region of malaria infection and has a population of 1,829,187. It has 11 local governments, out of which 6 were selected. These are : Ona Ara, Ibadan SouthEast, Ibadan South West, Ibadan NorthWest, Ibadan Northeast and Ibadan North. The following areas were also selected in the selected LGA's: Orita Aperin, Aremo, Atipe Oke Ofa, Iwo road, Old Ife road, Basorun, Monatan, Oke Are, Bodija, Agbowo, Agodi gate, Agodi GRA, Agbeni, Oranyan, Molete, Challenge, Oluyole Estate, Ososami, Imalefalafia and Ogbere.

Sampling Procedure:

Communities were stratified into high and low drug resistant areas based on the evidence of record review of addresses of patients that received treatment at the malaria clinic of the drug resistant network of the Malaria Research Laboratories Adeoyo Hospital, Ibadan in the past two years, 2000-2001. One thousand one hundred and two respondents were randomly selected. Criteria for selection were based on those subjects who had malaria not more than 2 months before the survey and who could recall the treatment sought. There were 502 respondents in the high drug resistant areas (HR) and 600 respondents in the low drug resistant areas (LR).

Data collection

Interviewers were trained to administer a semi-structured questionnaire developed to obtain information on Knowledge, Attitude and Practice of malaria prevention and treatment, illness behaviour, medication knowledge, pattern of drug use, compliance with therapy and factors that could be associated with clearance or non-clearance of infection (i.e. treatment successes or failures).

Data analysis

Data were entered into the computer using the Epi Info version 6 statistical package. Indices such as means, medians and standard deviations were used to summarize the quantitative variables while the categorical variables were summarized by percentages. The chi–squared test and Fisher's exact test were used to investigate associations where appropriate. A p value of 0.05 or less was interpreted as being statistically significant. Where there were multiple tests, the Bonferroni correction was applied to maintain the level of significance.

Results

Complete information was available for 1091 respondents at the end of the study (501 in the high resistance group and 590 in the low resistance group), yielding a response rate of 99.1%. Less than 10% of the respondents were below 20 years of age, however, the mean (± SD) age was 32.3 ± 12.0 years. The two groups were significantly different when their socio demographic characteristics were compared. ($P<0.05$). There were 545 (50.0%) males, and 546 (50.0%) females. Table 1 provides the socio-demographic characteristics of the respondents. Mean (± SD) income per month for the 2 groups were N5623.7 ± 5749.7 and 11026.65 ± 10,437.8 respectively ($P<0.05$)

Malaria prevention: Knowledge and Bed net use.

In the high resistant area (HR), four hundred and sixty four (93.4%) reported that malaria could kill and 33 (6.6%) said "No", while in low resistant area (LR), 541 (92.2%) reported that it could kill against 46 (7.8%) that said "No" ($P>0.05$). Majority, (98.2%) reported that young children, adults and pregnant women can die of malaria. Majority, (89.5%) also reported that malaria infection is preventable in both groups. Ways of prevention mentioned included: having clean environment, chemoprophylaxis, use of insecticide, use of herbs/traditional medicine and personal hygiene.

Table 1: Socio-demographic characteristics of respondents

Age	HR Group Freq.	%	LR Group Freq	%	p-value
0-19	38	7.6	40	6.8	
20-39	326	65.5	414	70.9	0.002
40-59	102	20.5	119	20.4	
>60	32	6.4	11	1.9	
Total	498	100.0	584	100.0	
Sex					
Male	212	42.3	333	56.4	0.000
Female	289	57.7	257	43.6	
Total	501	100.0	590	100.0	
Religion					
Xtianity	191	38.4	411	69.8	
Islam	299	60.2	173	29.4	0.000
Traditional	7	1.4	5	0.8	
Total	497	100.0	589	100.0	
Marital status					
Married	332	66.3	361	61.3	
Single	135	26.9	221	37.5	0.000
Divorced	12	1.0	3	0.2	
Widowed	22	4.4	4	0.7	
Total	501	100.0	589	100.0	
Highest level of Education					
No formal Education	91	18.2	53	9.1	
Primary Educ.	131	26.1	70	12.0	0.000
Secondary Educ.	241	48.1	304	52.0	
University/Poly Educ.	38	7.6	158	27.0	
Total	501	100.0	585	100.0	
Occupation					
Farming	5	1.0	7	1.20	
Artisan	123	25.1	154	26.4	
Trading	258	52.7	258	44.2	
Civil servants	24	4.9	81	13.9	
Student/apprent.	51	10.4	73	12.5	0.000
Clergy	16	2.7	2	0.34	
Retired/Unemployed	13	2.7	9	1.54	
Total	490	100.0	584	100.0	

Forty five (9.1%) reported that they use bednets in the HR group while 49 (8.4%) also reported that they use bednets in the LR group (P >0.05). Out of these 45 in group 1, 24 (53.3%) were children while 21 (46.7%) were adults comprising 15 (33.3%) males and 30 (66.7%) females. Their mean±S.D age was 33 ± 11.9yrs. Majority, 27 (60%) had secondary school education and university education. The other 18 (40.0%) had primary education, modern school education and no formal education. Out of the 49 that had bednets in the second group, only 21 slept under them, 11 (52.4%) of whom were children while 10 (47.6%) were adults. Twenty four (49.0%) of these were males and 25 (51.0%) females. Their mean age was 30.0 ± 12.6 yrs years. Majority, 34 (69.4%) also had secondary school and university education. The remaining 15 (30.6%) had primary education, modern school education and uncompleted secondary education. Reasons given for not using bednets included: non-affordability, "they don't see it as necessary" and discomfort. Other reasons are shown in table 2. 72 (14.3%) had windownets in the LR group compared to 34 (9.1%) in the HR group. (P<0.05). Average number of bednets per household in the HR and LR groups are 1.0 (±1.2) and 1.5 (± 0 .76) respectively.

Table 2: Percentage Distribution of Reasons given for not using Bednets.

	HR Group		LR Group		
Reasons	Freq.	%	Freq.	%	P-value
Lack of awareness	37	9.9	21	4.2	0.0006
No more in vogue/ don't see it as necessary	68	18.2	192	38.0	0.000
Not meant for adults	47	12.6	70	13.9	0.587
Dislike	28	7.5	43	8.5	0.588
Non-Affordability	82	22.0	78	15.4	0.013
Already using insecticide	25	6.7	8	1.6	0.000
Mosquitoes not present in houses	13	3.5	4	0.8	0.004
Availability of window nets	34	9.1	72	14.3	0.021
Discomfort	14	3.8	5	0.99	0.005
Don't know where to purchase one	25	6.7	12	2.4	0.002
Total	373	100.0	505	100.0	

Table 3: Percentage distribution of action taken when symptoms were first noticed

	HR Group		LR Group		
First action taken	Freq.	%	Freq.	%	P-value
Treated with drugs available at home	57	12.03	95	16.4	
Treated it with herbs	88	18.57	61	10.5	
Visited the drug stores	265	55.91	269	46.5	0.00
Visited PHC	34	7.17	15	2.6	
Visited the hospital	30	6.33	5	24.0	
Total	474	100.0	579	100.0	

In the HR group, 10 (45.5%) agreed to show their nets compared to 2 (40.0%) in the LR group. Also, 21 (80.8%) respondents reported that their nets hanged over a bed in the HR group compared to 19 (67.9%) in the LR group (P>0.05). The median cost of a net in both groups is N400.00 and N425.00 respectively. The average cost in the HR group was N554.70 ± N620.7 while in the LR group it was N506.00 ± 450.00 (P>0.05). Only 3 respondents impregnated their nets with insecticides in both groups. Average cost per treatment in both groups was N200 ± 70.77 and N264 ± 182.8 respectively. One hundred and thirty two (79.5%) respondents agreed that the nets were effective in preventing mosquito bites in the HR group, compared to 119 (74.8) in the LR group (P>0.05). Fifteen (3.0%) were aware of ITN in the HR group compared to 62 (10.6%) in the LR group (P<0.05). Four hundred and forty four (91.9%) respondents thought that drugs could be used to prevent malaria in the HR group compared to 497 (90.4%) in the LR group (P>0.05). Three hundred and seventy four (78.0%) actually used drugs to prevent malaria in the HR group compared to 310 (55.6%) in the LR group (P<0.05). Majority, 152 (40.69%) of these 374 people had secondary and university education. The drugs used by respondents for treatment are "Fansidar" (10.0%), analgesics (26.2%), chloroquine 74(20.6%), "Daraprim" 18(5.0%), "Maloxine" 13(3.6%), "akapo[1]" 31 (8.6%), herbs 40 (11.1%) and others 53 (14.9%). In the LR group, the drugs used were : "Fansidar" 31 (10.85), analgesics32(11.2%), chloroquine 101 (35.3%), "Daraprim" 19 (6.6%), "Maloxine" 47(16.4%), herbs 20(7.0%) and others 36 (12.6%).

Treatment Seeking Behaviour

Four hundred and fifty nine in the HR group (96.6%) and 553 in the LR group (97.4%) had malaria in the past 2 months. The following symptoms were reported: fever, rigor/chill, headache and pains, joint pains, vomiting, tiredness and loss of appetite. The commonest symptoms were fever and rigor/chills. Table 3 shows the percentage distribution of what respondents did first when they noticed the symptoms.

Two hundred and forty seven (49.3%) waited for 1-2 days to confirm if it was malaria before they took the action reported above in the HR group compared to 252 (43.6%) in the second group (P>0.05). Fifty seven (11.75%) waited for more than 2 days in the HR group compared to 57 (9.9%) in LR group. (P>0.05). 181 (37.32%) took action immediately in the HR group compared to 269 (46.5%) in the LR group and 412 (85.12%) reported that they decided on their own in the HR group compared to 510 (89.6%) in the LR group. Seventy (50.7%) reported that the health facility visited was within the community in the HR group compared to 217 (59.9%) in the LR group (P<0.05) (Table 4).

Table 4: Percentage distribution of distance of health facility from Respondents' Houses

Distance	HR Group Freq.	(%)	LR Group Freq.	(%)	p-value
Within the community	70	50.7	217	59.9	
Next street	21	15.2	76	21.0	
Few km. Away	47	34.1	69	19.1	
Total	138	100.0	362	100.00	0.002

In the HR group, 49 (89.1%) respondents reported that they did not encounter any problem while seeking the care described, 6 (10.9%) reported that the problems they encountered are transportation, unnecessary delay and lack of adequate care. Respondents in the LR group did not report any problem at all. Cost of seeking treatment ranged from N5 to N2,100.00 in the HR group and N10 to N13,000.00 in the LR group. The mean costs (± SD) in both groups were N214.65 ± 361.3 and N796.7 ± 40.6 respectively (P<0.05).

Pattern of mobility

The pattern of mobility of respondents was investigated to see the possibility of infection from one area to the other. Two hundred and thirty six (50.3%) respondents reported that they left their places of residence for long in the HR group compared to 216 (37.9%) in the LR group 2 (P <0.05). The first group reported that they spent an average of 9.5 days (± 14.7) when they left their places of residence compared to 7.6 days ± 11.9 in the second group (P>0.05). Seventeen (6.7%) slept under bednets when they travel in the HR group compared to 5 (2.2%) in the LR group 2 (P<0.05). These nets are not ITN. Forty one (16.0%) reported that they came down with malaria when they got back to their base in the HR group compared to 31 (13.24%) in the LR group. (P<0.05)

Pattern of antimalarial drug use and compliance with therapy

The following drugs were prescribed at the clinic or patent medicine store: "Maloxine", analgesics, chloroquine, "Fansidar" etc. Two hundred and four (80.6%) obtained the prescribed drugs at clinic/patent medicine store in the HR group compared to 359 (95.2%) in the LR group (P<0.05). Those that did not obtain the drugs from the clinic reported that the drugs were too expensive or were out of stock. The median costs of the drugs for the 2 groups were: N50 and N120 respectively. Consultation fee ranged from N20 to N1500.00 in the HR group and N10.00 to N2,000.00 in the LR group. Total cost of treatment ranged from N5 to N2,500.00 in the HR group and N10.00 to N3,000.00 in the LR group. Forty (16.6%) reported that the person who sold drugs requested for prescription before selling the drugs in the HR group compared to 71 (31.4%) in the LR group (P <0.05). Three hundred and twenty nine (91.4%) reported that they used all the drugs in HR group compared to 440 (88.7%) in the LR group (p>0.05). Twenty seven (7.5%) used some of the drugs in the HR group compared to 53 (10.7%) in the LR group, while 4 (1.1%) did not use at all in the HR group compared to 3 (0.6%) in the LR group. Those that did not use all the drugs complained that they reacted to them and it took too long to complete the dosages. Out of those that used all the drugs in the HR group, the symptoms of the infection were relieved totally in 278 (87.7%) respondents while 34 (10.7%) reported that there was relapse, and 5 (1.6%) reported that there was no improvement. In the LR group, 440 (88.7%) used all the drugs: the infection cleared in 388 (89.0%), 42 (9.6%) reported that there was relapse while the situation remained the same in 6 (1.4%) respondents.

For those that used some of the drugs in the HR group, the symptoms of the infection were relieved in 18 (66.7%) respondents; 7 (25.9%) reported that there was relapse while 2 (7.4%) reported that there was no improvement. For the LR group, 36 (70.6%) reported that the symptoms of the infection were relieved and 15 (29.4%) reported that there was relapse. (Table 5) shows outcome of treatment in both groups.

Table 5: Percentage distribution of outcome of treatment in both groups

Treatment Outcome	HR Group Freq.	%	LR Group Freq.	%	P-value
Infection cleared	360	85.3	495	87.3	0.363
Infection re-occurred	50	11.8	63	11.1	
No improvement	12	2.8	9	1.6	
Total	422	100.0	567	100.0	

Out of the 339 who complied with treatment in the HR group, the frequency of treatment failure was 12.4%, however, out of the 482 that complied in the LR group, the frequency of treatment failure was 10.9%. There was no significant difference between outcome of treatment in both groups; it was suspected that "whether or not they completed the treatment could be a confounding factor. When this factor was used to stratify, the results showed that the two groups were not significantly different with respect to clearance of infection, but there was a significant difference between clearance of infection and whether or not the respondent completed the treatment ($P<0.05$), (Table 6)

Table 6: Clearance of infection by whether or not treatment was completed

	Completed treatment	Infection cleared	Infection cleared & re-occurred	Total	P-value
HR Group	Yes	297	42	339	0.028
	No	16	7	23	
	Total	313	4	362	
LR Group	Yes	429	53	482	0.002
	No	24	11	35	
	Total	453	64	517	

When both groups were combined, the Mantel-Haenszel test showed that the results were significant, $P=0.00001$. OR =3.44 (CI =1.8-6.51) i.e. those that completed treatment are three times more likely to have their infection cleared than those that did not complete treatment. (Table 7). Clearance of infection was not associated with age, income, religion, sex and type of drug ($P>0.05$.

Table 7: Clearance of Infection by whether or not treatment was completed in both groups.

Completed treatment	Infection cleared	Infection cleared & re-occurred	Total	P-value
Yes	726	95	821	
No	40	18	58	0.00001
Total	766	113	879	

Majority of the respondents did not use the correct doses appropriately in both groups. For those that used tablets, the number of tablets taken on Day 1 ranged from 1 to 12 in the HR group and 1 to 20 in the LR group, mean (± SD) number of tablets in the HR group was 3.7 ±2.1 compared to 4.5 ±2.55 in the LR group ($P<0.05$). On Day 1, majority of the respondents used chloroquine although in incorrect doses. Number of chloroquine tablets used on day one ranged from 1 to 10 tablets for the HR group and 1 to 8 tablets for the LR group. Three hundred and forty nine (93.8%) reported that they completed the treatment in the HR group compared to 487 (92.9%) in the LR group; 23 (6.2%) did not complete the treatment in the HR group compared to 37 (7.1%) in the LR group. Reasons given for not completing treatment included: too many drugs, lack of money, first dose gave relief. Forty (53.3%) reported that the infection relapsed in less than a week in the HR group, compared to 14 (17.7%) in the LR group, ($P<0.05$). This can be likened to early treatment failure (ETF) or (R3). Sixteen (21.3%) reported that there was relapse a week later in the HR group compared to 19 (24.1%) in the LR group ($P>0.05$). This can also be likened to late treatment failure (LTF) or (R1/R2), while 19 (25.3%) reported that the infection relapsed after more than one week in the HR group compared to 46 (58.2%) in the LR group ' (R1/R2) i.e LTF.

Twenty two (31.4%) reported that they repeated the drugs when they noticed reappearance of symptoms in HR group compared to 47 (52.2%) in LR group. The antimalarial drug mostly used after reappearance of symptoms is chloroquine.

The results also revealed a high level of knowledge of environmental factors that made people get malaria. These include dirty drainages, overgrown bushes and staying outdoors in the evenings. One hundred and eight (23.6%) reported that these factors are present to a large extent in the HR group compared to 55 (10.2%) in the LR group; 262 (57.2%) reported that the factors were present to some extent in the first group compared to 406 (75.6%) in the second group. Eighty-one (17.2%) reported that they used "akapo" to treat malaria all the time in the HR group compared to 26 (4.5%) in the LR group, 262 (55.5%) did not use it at all in the HR group compared to 450 (77.9%) in the LR group.

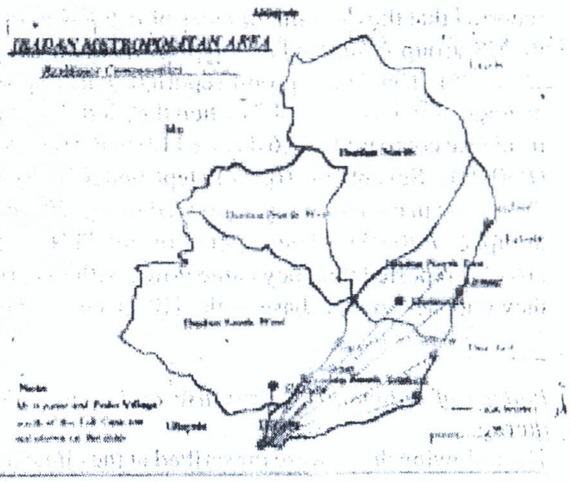

Fig. 1.: Ibadan metropolitan area

Disscussion

The results revealed a high level of knowledge of malaria and how it could be prevented in both groups. However, very few people used bednets particularly insecticide treated bednets (ITN). The majority were not aware of ITN particularly in high resistant group; and the few that were aware in the low resistant group did not use it. Use of ITN may be enhanced through increased awareness, higher subsidy for the initial purchase of the nets and the establishment of community treatment centers.

Results also revealed a high level of drug use, particularly chloroquine. However, the doses were inappropriate. This could favour the selection of drug resistant parasites. Respondents in the low resistant group had health facilities very close to their houses. This could be a reason why they did not encounter problems in seeking care. This was not the case with the first group. This might be a reason for prescribing drugs themselves or their use of "akapo". Results also showed that prescriptions were asked for more often from those in the second group than those in the first group. This difference is statistically significant. Also, respondents in the low resistant group did not leave their places of residence for long as much as those in the high resistant group and they did not use bednets when they got there. They could also bring back malaria from these places to their original places of residence. Their pattern of mobility may spur the emergence of drug resistant infections in their areas. The environmental factors that make people get malaria was more prevalent in the high resistant group than in the low resistant group.

The results showed that the two groups were not significantly different with respect to clearance of infection. Where the respondents reside (i.e. their socio economic status) had no effect on clearance of infection. But whether or not they completed the treatment was related to clearance of infection. Results revealed that those that completed treatment were three times more likely to have their infection cleared than those who did not complete treatment. This study has shown that those who were noncompliant with treatment were more likely to fail treatment than those who were compliant. This is consistent with the findings of Lobel, Phillips-Howard, and Berhens. [8,9,10,11]. This study has investigated the issue of compliance by examining whether or not treatment was completed. This analysis used self-reported compliance. There might have been marked discrepancies between the reporting of compliance and the actual compliance of the respondents. If both groups were equally likely to misrepresent compliance to treatment, the true effectiveness of compliance may even be larger than that reported here. Overall, over 90% were compliant with treatment in both groups. This is consistent with the experience of others based on data also obtained from questionnaire surveys. [8,9,13]. Previous studies have shown that women are more compliant with antimalarial chemoprophylaxis than men; our data also support these observations.[9,14].

In conclusion, this study demonstrates that those who are noncompliant are more likely to fail treatment (which may favour the selection of drug resistant parasites) than those who are compliant irrespective of their socio-economic status. It is recommended that adequate health education about the risks of malaria and the importance of compliance be given to the residents in this environment.

Acknowledgments

This study was supported by a grant from the Multilateral Initiative on Malaria (MIM)/ Special program for research and training in Tropical Diseases Research (TDR) Malaria Research Capacity Strengthening Grant. (ID 980080).

Appendix

RI level of resistance is described as initial clearance of parasitaemia within 7 days of treatment followed by recrudescence of infection during a 14-day follow up period.

R2 resistant infections occue when marked reduction in parasitaemia, by more than 75% is observed within 48 hrs. of initiating therapy but no clearance of infection is recorded.

R3 level of resistance represents an infection in which no marked reduction of a sexual parasitaemia is observed within 48 hrs. of drug administration.

[1] *"akapo" is a combination of drugs like antimalarials, antibiotics, blood capsules and analgesics.*

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Received: 22/11/02
Accepted: 07/06/05