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Adherence To Malaria Prophylaxis Among Peace Corps Volunteers in the Africa Region, 2013

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Abstract

Background—Although malaria can be prevented with prophylaxis, it is diagnosed in over 100 Africa-region Peace Corps Volunteers annually. This suggests that prophylaxis non-adherence is a problem in these non-immune travelers.

Methods—We investigated Volunteers' knowledge, attitudes, and practices regarding prophylaxis using an internet-based survey during August 19–September 30, 2013. Adherence was defined as taking doxycycline or atovaquone-proguanil daily, or taking mefloquine doses no more than 8 days apart.

Results—The survey was sent to 3,248 Volunteers. Of 781 whose responses were analyzed, 514 (73%) reported adherence to prophylaxis. The most common reasons for non-adherence were forgetting (n=530, 90%); fear of long-term adverse effects (LTAEs; n=316, 54%); and experiencing adverse events that Volunteers attributed to prophylaxis (n=297, 51%). Two hundred fourteen (27%) Volunteers reported not worrying about malaria. On multivariate analysis controlling for sex and experiencing adverse events Volunteers attributed to prophylaxis, the factor most strongly associated with non-adherence was being prescribed mefloquine (OR 5.4, 95% confidence interval 3.2–9.0).

Conclusions—We found moderate adherence and a prevailing fear of LTAEs among Volunteers. Strategies to improve prophylaxis adherence may include medication reminders, increasing education about prophylaxis safety and malaria risk, and promoting prompt management of prophylaxis side effects.

Keywords

malaria prevention; malaria in long-term travelers; malaria chemoprophylaxis

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Author's contribution statement

KL, KT, and PA designed the study. KL implemented the study with technical assistance from KT and PA. KL analyzed the data with assistance from KT. KL drafted the manuscript with critical review and revision from KT and PA.

Conflict of Interest

The authors declare no conflict of interest.

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1. Background

Since 1961, over 215,000 Peace Corps Volunteers (Volunteers) have served worldwide, 46% of them in Africa. Most Volunteer deployments last 27 months; as long-term travelers to this area, Africa-region Volunteers are at high risk for malaria infection. Peace Corps policy requires Volunteers in malaria-endemic countries to take malaria prophylaxis. However, malaria is diagnosed in over 100 Africa-region Volunteers each year, suggesting that non-adherence to prophylaxis is a problem in this population of non-immune travelers.

Concerns about adverse effects of prophylaxis, which are reported by many Volunteers and other travelers to malaria-endemic areas, are suspected to play a large role in non-adherence. In a cross-sectional study of 2701 Volunteers conducted between 2005 and 2006, 62% of respondents reported having a side effect that they attributed to prophylaxis, and 28% reported changing prophylaxis as a result [1]. In a 2003 randomized, double-blinded, placebo-controlled study of 623 non-immune, short-term travelers to sub-Saharan Africa, 85% of participants reported a side effect of prophylaxis [2]. It is unclear what proportion of symptoms attributed to prophylaxis are truly side effects of the medicine rather than normal events related to long-term travel: in a randomized, double-blinded, placebo-controlled study of mefloquine versus atovaquone-proguanil in 1013 patients presenting to travel clinics in 1999, 62% of treatment-emergent adverse effects were determined by the investigators to be unrelated to the study drug [3]. Studies of adherence to long-term malaria prophylaxis in populations of travelers have shown that adherence is poor overall, and that fear of long-term adverse effects (LTAEs), conflicting advice, and complicated or daily dosing strategies are common reasons for non-adherence [4,5].

The U.S. Centers for Disease Control (CDC)-recommended options for prophylaxis in Africa are mefloquine, doxycycline, and atovaquone-proguanil (Malarone™). From as early as 1995 until 2012, Peace Corps policy recommended mefloquine as the drug of choice for Volunteers without a history of psychiatric illness serving in Africa region countries. In December 2012, in response to concerns on mefloquine safety expressed by some Volunteers, and in hopes of increasing overall adherence, the policy was changed to make all prophylaxis options equally available. Peace Corps Medical Officers (PCMOs) are responsible for Volunteer education pre-deployment about the use and importance of uninterrupted prophylaxis, selection of prophylaxis, and management of long-term use of prophylaxis for the duration of Volunteers' service [6]. They are instructed to individualize their choice of agent based on area-specific recommendations (e.g., some Volunteers serve in regions where CDC does not recommend malaria prophylaxis), drug contraindications and precautions, drug tolerance, and dosing schedules. According to Peace Corps policy, Volunteers non-adherent to prophylaxis can be terminated from their Peace Corps service. Peace Corps has followed this policy.

Between July 7 and September 30, 2013, CDC conducted qualitative and quantitative evaluations among active Volunteers with the aim of identifying risk factors for non-adherence to malaria prophylaxis. We present the findings of the quantitative evaluation.

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2. Methods

In July 2013, we conducted focus-group discussions with convenience samples of 30 active, consenting Volunteers in Zambia, a country with high rates of malaria among Volunteers (3.9 cases per 100 Volunteer years in 2012[7]), and Senegal, a country with low rates of malaria among Volunteers (0.8 cases per 100 Volunteer years in 2012). We also conducted interviews with these countries' PCMOs and each country's Peace Corps directorship. Content of these evaluations centered around participants' views on and personal experience with malaria and malaria prophylaxis, sources for health advice, views on Peace Corps administration policies, and Volunteer-PCMO relationships. CDC staff used transcripts of these discussions to develop an internet-based survey using SurveyMonkey (SurveyMonkey, Palo Alto, CA). A survey was deployed August 19, 2013 by the Peace Corps offices of all 23 countries with active posts in the Africa region to all active Volunteers in-country. The survey was open until September 30, 2013, and completed anonymously by consenting Volunteers.

The survey contained questions on currently prescribed malaria prophylaxis and dosing; current symptoms attributed to prophylaxis and feared LTAEs (adverse effects occurring after Peace Corps as a result of taking prophylaxis during Peace Corps); reasons for taking, not taking, or changing prophylaxis; malaria diagnosis, testing, and care history during Peace Corps service; knowledge and attitudes related to Peace Corps policies regarding non-adherence, malaria, and medication in general; country/region of service; use of tobacco and recreational drugs, and general demographics. Peace Corps-Headquarters provided aggregate, anonymous demographic data on Volunteers in countries where the survey was implemented. These data included median age, gender distribution, number of first- and second-year Volunteers in each country, and case rates of laboratory-confirmed malaria from the year 2012.

Responses were received from Volunteers serving in all countries in the region, including six countries where malaria endemicity is non-uniform enough that CDC's prophylaxis recommendations vary within the country: Ethiopia, Kenya, Tanzania, Namibia, Botswana, South Africa. Although Peace Corps recommends malaria prophylaxis for all Volunteers serving in Ethiopia, Tanzania, and Kenya, Volunteers in all six of these countries may have had contact with people who were appropriately counseled not to take prophylaxis. Because this might have affected their attitudes toward prophylaxis, we excluded all respondents from these six countries.

Descriptive analysis was conducted using SAS 9.3 (SAS Institute, Cary, NC). Adverse events were grouped by organ system for portions of the analysis: neuropsychiatric symptoms were defined as nightmares/vivid dreams, anxiety, insomnia, dizziness/vertigo, depression, limb numbness, psychosis, headache, and tinnitus; gastrointestinal symptoms were defined as heartburn, nausea/vomiting, diarrhea, mouth ulcers, constipation, and dyspepsia; dermatologic symptoms were defined as sun sensitivity, rash, acne changes, and other skin complaints; genitourinary symptoms were defined as yeast infections and urinary disturbances; and consistutional symptoms were defined as hair loss, weight changes, and fever). For Volunteers prescribed mefloquine, adherence was defined as taking doses of the

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medication no more than eight days apart. For those prescribed atovaquone-proguanil or doxycycline, adherence was defined as taking the medication once a day at any time of day. Odds ratios were calculated for all major factors assessed in the survey. Factors significant on crude analysis were further analyzed using multivariate logistic regression to identify predictors of non-adherence.

3. Results

3.1 Geography and demographics

An email describing and linking to an online Volunteer survey was sent to 3,248 Volunteers across 23 countries in the Africa region, 2,307 of them serving in countries with uniform prophylaxis recommendations. We received 1,184 unique, valid responses to the survey between August 19th and September 30th, 2013. After excluding 193 respondents who did not identify the country in which they were serving and 210 from countries with non-uniform prophylaxis recommendations, survey data from 781 respondents remained, yielding a response rate of 34%. Volunteers from countries with uniform recommendations were more likely to be <26 years old than those from countries with non-uniform recommendations (59% vs. 45%, X^2=12.6, p<0.001), and were more likely to have served >1 year in Peace Corps (61% vs. 31%, X^2=92.1, p<0.001); there were no statistically significant differences in sex between the groups.

To determine whether geographic differences in malaria incidence among Volunteers were associated with differences in response rates, we compared country response rates with malaria case rates reported by each country's PCMO team. There was no correlation between response rates and case rates (Spearman rho −0.13, p = 0.0.67; Table 1).

To determine the representativeness of the Volunteers included in the study compared to survey invitees, we compared median age, proportion female, and years of service between the two groups. The median age group of included Volunteers was 22–25 years, comparable to 25 years among invitees. Five hundred twenty-six (68%) included Volunteers were female, compared to 2069 (64%) invitees (p=0.028), and 307 (39%) were in their first year of service, compared to 1515 (47%) invitees (p<0.001).

3.2 Adherence to prophylaxis

Three hundred eighty Volunteers (49%) reported being prescribed mefloquine, 304 (39%) doxycycline, and 97 (12%) atovaquone-proguanil. Two hundred seventy-six (35%) respondents reported having changed prophylaxis at some point during their service.

Of 703 respondents reporting how often they take their prescribed prophylaxis, 514 (73%) reported taking it in adherence with their prescribed dosing regimen. Adherence was 90% among those prescribed atovaquone-proguanil (n=77), 84% (n=231) among those prescribed mefloquine, and 60% (n=206) among those prescribed doxycycline.

Thirty-eight (5%) and 29 (4%) respondents reported taking prophylaxis only seasonally and only when traveling away from their posts, respectively, and 335 (72%) females and 174

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(75%) males reported adherence. Among all age groups, adherence was lowest in respondents aged 22–25 years.

3.3 Reasons for non-adherence

The most commonly cited reason for adherence to prophylaxis was the perception that the prophylaxis prescribed was effective at preventing malaria (n=747, 98%). The most common reasons for non-adherence were forgetting to take prophylaxis (n=530, 90%), fear of long-term adverse events (n=316, 54%), and having experienced adverse effects they attributed to prophylaxis (n=297, 51%). Other reasons for adherence and non-adherence are listed in Table 2.

Among those who reported forgetting as a reason for non-adherence, the most commonly reported setting was travel or another disruption in routine (n=266, 49%). Among those who forgot prophylaxis while traveling, not bringing prophylaxis (n=232, 87%) was more common than bringing prophylaxis and forgetting to take it (n=39, 15%).

Two hundred seventy-six (38%) of 724 Volunteers acknowledged fear of having LTAEs after their Peace Corps service. The LTAEs most commonly feared were neuropsychiatric problems (n=155, 56%), unspecified problems (n=101, 37%), cancer (n=32, 12%), and sun sensitivity (n=31, 11%). Twenty-seven (10%) Volunteers were concerned about liver problems as an LTAE of prophylaxis.

Of 733 Volunteers, 359 (49%) experienced adverse events during Peace Corps service that they attributed to prophylaxis: 219 (61%) were prescribed mefloquine, 133 (37%) were prescribed doxycycline, and 7 (2%) were prescribed atovaquone-proguanil. Of all 380 patients prescribed mefloquine, 215 (57%) attributed a neuropsychiatric event to the drug, most commonly nightmares/vivid dreams, anxiety, and insomnia. Adverse events most commonly reported by those prescribed doxycycline were sun sensitivity, nausea/vomiting, and heartburn, and those most commonly reported by those prescribed atovaquone-proguanil were nausea/vomiting, nightmares/vivid dreams, and insomnia (Table 3, column percents).

Among all Volunteers experiencing any adverse event they attributed to prophylaxis, neuropsychiatric events were reported by 242 (67%), while 118 (33%) reported gastrointestinal events, 102 (28%) reported dermatologic events, 66 (18%) reported constitutional events, and 37 (10%) reported genitourinary events. Among neuropsychiatric adverse events reported, nightmares/vivid dreams, anxiety, and insomnia were most common. All adverse events attributed to prophylaxis irrespective of respondent adherence are listed in Table 3.

Among Volunteers who did not experience adverse events that they attributed to their prophylaxis, adherence to atovaquone-proguanil was 91% (n=72), adherence to doxycycline was 90% (n=128), and adherence to mefloquine was 74% (n=94).

3.4 Malaria knowledge, history, and health behaviors

Of Volunteers answering questions on their knowledge about morbidity/mortality risks related to malaria, 758 (99%) correctly indicated that it was possible to die from malaria and

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636 (97%) correctly indicated that it is possible to get permanent disability from malaria. Only 61 (10%) indicated that it was highly likely a person would die if they became infected with malaria, and 74 (12%) indicated that it was possible to become immune to malaria by being infected with malaria.

Two hundred fourteen (27%) Volunteers indicated they were not worried about malaria, most often because they believed malaria can be treated quickly (n=181, 85%). Other common reasons were knowing non-host country nationals (HCN; n=93, 44%) or HCN (n=71, 33%) who had survived malaria, the belief that malaria is treatable and not a serious disease (n=4, 20%), and having personally survived malaria (n=48, 22%).

Seventy-nine (10%) Volunteers reported having been diagnosed with malaria during their Peace Corps service, and 332 (43%) acknowledged having had at least one malaria test during their service. Although 119 (15%) Volunteers had been tested for malaria by their PCMO, 201 (26%) had been tested for malaria elsewhere, and 69 (9%) had been tested for malaria with a rapid diagnostic test (RDT) not supplied by Peace Corps. Thirty-three (4%) Volunteers had taken an antimalarial drug not prescribed by Peace Corps.

When asked whom they would contact first when ill, 461 (59%) Volunteers answered, “a PCMO.” Two hundred twenty-five (29%) Volunteers acknowledged having called their PCMO with malaria symptoms, while 114 (15%) Volunteers acknowledged having had malaria symptoms without calling the PCMO. Nine (1%) Volunteers acknowledged having lied to the PCMO about an RDT result for any reason. Nineteen (2%) Volunteers reported using recreational drugs at least once a week. Six hundred ninety-eight (91%) Volunteers answering questions about chronic medications indicated they either were taking long-term medications or would take long-term medications, or that it could be appropriate to take a medication for disease prevention.

3.5 Bivariate and multivariate analysis

Factors significantly associated with non-adherence on bivariate analysis are listed in Table 4. For the purpose of multivariable modeling, we excluded Volunteers prescribed malarone due to the relatively small number in this group. Treatment-seeking behavior, such as seeking diagnosis outside of PCMO care or self-treating with non-PC drugs, were not associated with nonadherence. In a model controlling for sex and experiencing adverse events that they attributed to prophylaxis, factors significantly associated with higher odds of non-adherence were being prescribed mefloquine (OR 5.4, 95% confidence interval [CI] 3.2–9.0), not being worried about malaria (OR 2.6, 95% CI 1.6–4.1), having been in Peace Corps service >1 year (OR 1.8, 95% CI 1.2–2.8), and being <26 years old (OR 1.7, 95% CI 1.1–2.6; Table 4).

4. Discussion

The most common reason Volunteers gave for non-adherence was simply forgetting, suggesting a role for reminder interventions. These may include strategies for self-managing medication or automated reminders, and could potentially include an SMS reminder system similar to those used throughout rural Africa for antiretroviral therapy [8].

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Fear of long-term adverse effects was another important reason for non-adherence. The top adverse effect feared by Volunteers was “unspecified problems,” and the next five most commonly feared symptoms were neuropsychiatric. When these five symptoms were cited as feared LTAEs, over 80% of the time it was by Volunteers prescribed mefloquine. Although mefloquine is known to cause neuropsychiatric effects in 10–15% of people while it is being taken [9,10], published data demonstrating mefloquine side effects presenting or persisting after discontinuation of the medication are limited to several case reports of ototoxicity [11]. Serious adverse events due to mefloquine are rare [12]. On July 29, 2013, the Food and Drug Administration (FDA) added a black-box warning to mefloquine labeling, advising providers and patients about the reports of long term ototoxicity.

About half of the Volunteers in our study attributed adverse events to their malaria prophylaxis, and the drug with the largest proportion of adverse events attributed was mefloquine (59%). In other studies, mefloquine adverse effects have been reported by 62% [1] and 67% [3] of adult subjects taking the drug. The three most commonly drug-attributed adverse events in our cohort were neuropsychiatric, and were also most commonly reported by Volunteers prescribed mefloquine. Neuropsychiatric events have been previously associated with mefloquine: in a randomized, double-blind trial comparing mefloquine to atovaquone-proguanil, 29% of subjects taking mefloquine had any neuropsychiatric event [3]. In that trial, 14% of those taking atovaquone-proguanil also reported neuropsychiatric events. Because atovaquone-proguanil is not considered to be a cause of neuropsychiatric side effects, these findings suggest that overattribution of adverse events to medications may be a concern in antimalarial drug safety studies.

Compared to that trial, a higher proportion of our respondents (56%) reported neuropsychiatric events, especially vivid dreams, anxiety, and depression. Several reasons may exist for this. First, Volunteers experiencing adverse events attributed to prophylaxis or with heightened concern for LTAEs may have been more motivated to respond to the survey, resulting in skewed measures of association. Second, substantial overlap exists between mefloquine side effects and symptoms associated with the stressors innate to Peace Corps service. Although these symptoms may be physiologic, Volunteers may identify them as a side effect of prophylaxis. Finally, many Volunteers are aware of mefloquine’s side effects due to increased publicity via the popular press, blogs, and social media. For example, although the FDA black box warning for mefloquine was issued only a month before the survey, several Volunteers were aware of the warning. The availability of Internet-based information sources among Volunteers compared to that among participants in other studies may be higher. Frequent recreational drug use was acknowledged by only 2% of respondents. Although this behavior may have been underreported, it seems unlikely to be a contributor to increased reporting of neuropsychiatric symptoms. Negative perceptions of mefloquine related to these sources may explain our finding that being prescribed mefloquine was the single factor most strongly associated with non-adherence on multivariable analysis, even when controlling for experienced adverse events attributed to prophylaxis. Under Peace Corps’ new policy allowing Volunteers equal access to all prophylaxis options, it may be easier for Volunteers who prefer a non-mefloquine option to change medications. Meanwhile, Volunteers who prefer the medication due to its weekly administration or for other reasons will be able to continue using it.

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Atovaquone-proguanil is a daily medication with few side effects [3,13], and few Volunteers experienced adverse events they attributed to it. Although this is a safe medication for many, its dosing and cost should be considered.

Of note, among reasons for non-adherence, Volunteers ranked concern for interaction with alcohol and other medications (including oral contraceptives) relatively low. No evidence exists to support the interaction of mefloquine, doxycycline, or atovaquone-proguanil with alcohol or oral contraceptives.

Almost all Volunteers knew that death and disability were possible consequences of malaria infection. However, 27% of Volunteers acknowledged not being worried about malaria, and this perception was associated with increased odds of prophylaxis non-adherence. When detected and treated early, malaria often has limited morbidity and mortality. However, the risk of progression to severe illness is not completely eliminated by early treatment, and in remote areas, obtaining comprehensive early care for malaria may be difficult. Volunteers must be educated on these risks, emphasizing that prevention is essential.

The practice of attributing even low-grade symptoms to malaria in their communities may lead to the perception that malaria is not something to be concerned about. Volunteers should be aware of malaria prevalence in their communities, and of the importance of obtaining the best-available healthcare, including proper diagnosis and treatment for malaria symptoms.

Twelve percent of Volunteers indicated that they thought it was possible to become immune to malaria by being infected. Most Peace Corps tours are unlikely to include sufficient malaria exposure to induce any meaningful immunity, and there is no laboratory test to measure partial immunity. The perception that repeated infections reduce risk can lead to riskier behavior, including non-adherence to prophylaxis.

The only health seeking behavior associated with nonadherence on crude analysis was not calling a PCMO when having malaria symptoms, reported by 15% of Volunteers and more common among non-adherent Volunteers. This practice can lead to delays in recognizing and treating malaria, further increasing the risk of progression to severe illness or death. Self-treatment of malaria was not associated with non-adherence, suggesting that non-adherers do not seem to be relying on self-treatment in place of prophylaxis. However, 4% of Volunteers acknowledged self-treatment with drugs not provided by Peace Corps—a concerning finding, given the high prevalence of counterfeit antimalarial drugs in sub-Saharan Africa [14]. Volunteers should be educated about the risks of self-treatment.

In our study, 73% of Volunteers reported adherence to antimalarial drugs; a relatively high proportion when compared to other studies of malaria prophylaxis in long term travelers with observed adherence between 59–62% of participants [5,15,16]). Volunteers younger than 26 years and with more than 1 year of Peace Corps experience had increased odds of non-adherence to prophylaxis. This may be explained by a greater sense of invulnerability in this population, and similar findings have been documented elsewhere: in a study of humanitarian workers, nonadherence to malaria prophylaxis increased in a linear fashion with the duration of mission, and was 81% in workers who had served in missions lasting 12

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to 18 months [17]. Interventions to improve adherence in more experienced Volunteers could include education both at the start of service and as a refresher course mid-service, with a focus on malaria morbidity and mortality and the important benefits of preventive medication.

Some strengths of this study included its relatively rapid execution, its dissemination to all Africa-region Volunteers, and its ability to measure multiple beliefs and behaviors. However, there were several important limitations to this study. First, the response rate among PCVs was only 34%, and non-response bias might have affected the results.. Volunteers who were non-adherent might have been less likely to participate, just as those who were adherent may have been more likely to participate, possibly resulting in the higher than expected proportion of respondents adherent to prophylaxis. Second, because the study relied on Internet access for survey completion, selection bias might have occurred (e.g. selecting for Volunteers posted to more urban areas or those with Internet-enabled devices). Because older Volunteers are more likely to be assigned to urban, well-resourced areas, this may have resulted in relatively reduced input from younger Volunteers. Third, because Volunteers knew adherence was expected from them, social desirability bias might have occurred. Finally, the exclusion of Volunteers from countries with geographically non-uniform prophylaxis recommendations might have selected for Volunteers exposed to fewer conflicting recommendations, resulting in participation of a non-representative population.

Although it is possible that Volunteers who feel more personally threatened by malaria may have been more likely to complete our survey, there was no statistically significant correlation between 2012 malaria case rates and response rate to our survey. It is unlikely there was a relationship between malaria incidence among a country’s Volunteers and their likelihood of responding to our survey.

On the basis of our findings, we have presented several strategies to improve malaria prophylaxis adherence in Peace Corps Volunteers and other long-term travelers to malaria-endemic countries, among them education that targets common fears and rumors about prophylaxis drugs, and automated or other reminder systems. The training curriculum delivered by PCMOs to Volunteers has already been updated and standardized, and Peace Corps is initiating evaluation studies to assess the impact of training (Barry G. Simon, MD, Peace Corps Medical Director; personal communication; August 2013). Given the importance of feared LTAEs in motivating non-adherence, there is a need for further study on this subject.

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Table 1

Volunteer participation and malaria case rates by country.

Country	Volunteers participating		Case rates of confirmed malaria among country Volunteers, 2012[7] (cases/100 Volunteers)
	N	(%)	
Togo	29	(3.7)	13.1
Sierra Leone	49	(6.3)	7.9
Uganda	61	(7.8)	7.6
Liberia	44	(5.6)	5.2
Malawi	16	(2.0)	4.6
Cameroon	89	(11.4)	4.6
Benin	80	(10.2)	4.1
Burkina Faso	15	(1.9)	4.1
Zambia	47	(6.0)	3.9
Mozambique	35	(4.5)	3.6
Ghana	84	(10.8)	3.5
Rwanda	42	(5.4)	1.5
The Gambia	34	(4.4)	1.2
Senegal	26	(3.3)	0.8
The Gambia	25	(3.2)	0
Madagascar	87	(11.1)	0
Swaziland	18	(2.3)	0

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Table 2

Reasons for adherence and non-adherence malaria prophylaxis cited by Volunteers.

Reason for adherence to malaria prophylaxis medication	Volunteers		Reason for non-adherence to malaria prophylaxis medication	Volunteers	
	N	(%)		N	(%)
I think the medication is effective at preventing malaria	747	(98)	I forget to take the prophylaxis	530	(90)
I'm worried about what would happen to my health if I get malaria	706	(93)	I am worried about having health problems after Peace Corps as a result of prophylaxis	316	(54)
The PCMO told me to take the medication	687	(90)	I have side effects of the prophylaxis when I take it	297	(51)
It is PC policy that I should take the medication	662	(87)	I do other things that are enough to keep me from getting malaria	217	(37)
I'm in an area where there are a lot of mosquitoes/malaria	649	(85)	I haven't had side effects, but worry I would have them	167	(29)
The malaria training in the PST[a] convinced me it was a good idea	643	(85)	I don't think I'm in an area where there are a lot of mosquitoes/malaria	165	(28)
I heard about someone dying of malaria and feared for myself	557	(73)	I've gotten conflicting advice about whether the prophylaxis was necessary	158	(27)
I fear being administratively separated if I get caught not taking it	540	(71)	I only take the prophylaxis seasonally	147	(25)
I saw someone sick with malaria and feared for myself	520	(68)	It's too hard to switch prophylaxis	134	(23)
Other PCVs Volunteers told me to take the medication	373	(49)	I'm not that worried about what will happen to my health if I get malaria	131	(22)
My doctor at home told me to take the medication	317	(42)	I worry that prophylaxis is ineffective malaria prevention	110	(19)
I have had malaria	17	(2)	I worry about the prophylaxis interacting with other meds I use	108	(18)
I like the side effects of the medication	3	(0)	I worry about interaction with alcohol	81	(14)
Prophylaxis is easy to take	3	(0)	I don't think it's right for me to be at lower risk for malaria than the population I'm living with	59	(10)
I am a STOMP Volunteer and fear being a hypocrite if I get malaria while in service	1	(0)	I worry about interaction with recreational drugs	18	(3)
I don't want to be a vector in my community	1	(0)	Unreliable food availability[b]	8	(1)
			Changes in routine	3	(1)
			Unsteady supply of prophylaxis	2	(0)
			Gastrointestinal side effects	1	(0)
			Fear of antibiotic resistance due to prolonged antibiotic use	1	(0)
			Concern for interaction with dairy	1	(0)

[a]PST, pre-service training.

[b]Volunteers described taking prophylaxis, especially doxycycline, only with a large meal to avoid gastrointestinal toxicity.

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Table 3

Adverse events attributed to prophylaxis among all Volunteers attributing any adverse event (n=359) and by prescribed drug.

	Total		Prescribed prophylaxis								
			atovaquone-proguanil			doxycycline			mefloquine		
Adverse event	**N**	**%**	**n**	**row %[a]**	**column %[b] (N=7)**	**n**	**row %**	**column % (N=133)**	**n**	**row %**	**column % (N=219)**
neuropsychiatric	242	(67)	4	(2)	(57)	23	(10)	(17)	215	(89)	(98)
nightmares/vivid dreams	181	(50)	2	(1)	(29)	6	(3)	(5)	173	(96)	(79)
anxiety	111	(31)	2	(2)	(29)	5	(5)	(4)	104	(94)	(48)
insomnia	104	(29)	2	(2)	(29)	8	(8)	(6)	94	(90)	(43)
dizziness/vertigo	55	(15)	0	(0)	(0)	3	(5)	(2)	52	(95)	(24)
depression	43	(12)	0	(0)	(0)	4	(9)	(3)	39	(91)	(18)
limb numbness	29	(8)	1	(3)	(14)	1	(3)	(1)	27	(93)	(12)
psychosis	6	(2)	0	(0)	(0)	0	(0)	(0)	6	(100)	(3)
headache	30	(8)	1	(3)	(14)	6	(20)	(5)	23	(77)	(11)
tinnitus	4	(1)	0	(0)	(0)	0	(0)	(0)	4	(100)	(2)
gastrointestinal	118	(33)	3	(3)	(43)	83	(70)	(62)	32	(27)	(15)
dermatologic	105	(28)	1	(1)	(14)	96	(94)	(72)	5	(5)	(2)
constitutional	66	(18)	1	(2)	(14)	12	(18)	(9)	53	(80)	(24)
genitourinary	37	(10)	1	(3)	(14)	34	(92)	(26)	2	(5)	(1)
Total having any adverse event	359	(100)	7	(2)	(100)	133	(37)	(100)	219	(61)	(100)

[a]Row percent is the number of those reporting an adverse event while prescribed a certain drug divided by the total number of people reporting the side effect (row N is the denominator).

[b]Column percent is the number of those who reported a specific adverse event divided by the total number of those reporting any adverse event while prescribed a certain drug (N listed in the “column %” heading for each drug is the denominator).

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Table 4

Factors associated with non-adherence.

	Bivariate analysis		Multivariate analysis	
	Unadjusted OR[a]	(95% CI[b])	Adjusted OR	(95% CI)
Mefloquine prescribed	*3.5*	*2.4–5.1*	*5.4*	*3.2–9.0*
Not worried about malaria	*3.3*	*2.2–4.8*	*2.6*	*1.6–4.1*
>1 years of Peace Corps service	*1.8*	*1.2–2.5*	*1.8*	*1.2–2.8*
Age <26 years	*1.8*	*1.2–2.6*	*1.7*	*1.1–2.6*
Attribute adverse events to prophylaxis	*1.9*	*1.2–2.8*	1.5	0.9–2.3
Sex female	1.2	0.8–1.8	1.0	0.6–1.6
Had malaria symptoms during Peace Corps but did not call the PCMO[c]	*2.1*	*1.3–3.3*	-	-
Diagnosed with malaria during Peace Corps[c]	*1.9*	*1.1–3.3*	-	-
Fear LTAEs[c]	*1.6*	*1.1–2.4*	-	-
Would take long-term medications for preventive purposes[c]	*0.5*	*0.3–0.9*	-	-
Feel is it likely to die from malaria infection[c]	*0.3*	*0.1–0.8*	-	-

[a]OR=Odds ratio

[b]CI=confidence interval

[c]Not included in final multivariable model