Factors influencing urban malaria: a comparative study of two communities in the Accra Metropolis

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Abstract

Background: As urban centres in Ghana continue to grow, the scale and impact of urban malaria is increasing.

Objective: To compare the prevalence of malaria in two communities and how this may be affected by knowledge, attitudes, socioeconomic status and preventive practices of residents in two communities within the Accra metropolis.

Methods: Giemsa-stained thick blood films were examined for malaria parasites in 400 people (200 each from townships with high and low urban status) from May to November 2009. Questionnaires were administered to determine and evaluate demographics of the participants. All participants lived within the two catchment areas, about 20 km apart.

Results: Average malaria prevalence among participants was 8.75%. Prevalence in Kaneshie (12%: p=0.032) was significantly higher compared to Airport West (5.5%). Illiteracy rate (17.5%), self-medication (81.5%) and the use of coils (21.0%) as a control mechanism was higher among residents of Kaneshie than Airport West. Most of the people (40%) in Kaneshie did not use any form of malaria control method. Insecticide spray was the most preferred malaria control mechanism by the Airport West residents (60.5%). Overall knowledge about malaria, employment status, housing conditions, level of overcrowding and the cost of treatment of malaria was better in Airport West than at Kaneshie.

Conclusion: Malaria prevalence and factors influencing its transmission differs within communities in the same urban area. It is therefore essential to develop control and prevention strategies based on the needs of specific communities.

Keyword: Malaria, prevalence, urbanization, demographics, insecticide spray, and insecticide treated nets.

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Introduction

Malaria still presents a serious health problem in Ghana; it is hyper-endemic with a crude parasite rate ranging from 10–70% with *Plasmodium falciparum* being the major parasite[1]. It is a major cause of morbidity accounting for 40% of outpatient attendance with annual reported cases of 2.2 million between 1995 -2001, and over 10% ending up on admission[2].

Rapid urbanisation may have serious effects on malaria prevalence and thus control. This can adjust the frequency and transmission modes of malaria, with huge implications for control[3].

Until recently, urban development was generally believed to reduce the risk of vector breeding, and thus malaria transmission[3]. However, many countries, including Ghana are struggling to cope with the rapid rate of urban growth and the resultant increase in the prevalence of malaria in the urban areas[3]. The prevalence and undercurrents of malaria transmission has been changed as a result of rapid urbanization culminating in significant effects on malaria morbidity and mortality and its consequent implications on the control of malaria[16].

Thus there is need to assess the malaria burden in urban areas together with information on personal, social and environmental factors to make way for more sound, area specific and effective control strategies. The study sought to identify factors, which may highlight differences in the prevalence of malaria,

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if any, and the effects of important behavioural, housing and vector control related parameters between two communities within an urban area in Accra, Ghana.

Methods

Study sites and design

This cross-sectional study was conducted in two communities, Kaneshie and Airport West residential area, both within the Accra metropolis in the Greater Accra region of Ghana. The region is located on the coordinates: 5°332 003 N 0°122 003 Wÿþ/ 5.55°N 0.2°W. It is the smallest of the 10 administrative regions of Ghana with its population accounting for 15.4 per cent of Ghana's total population[4]. Accra features a tropical savannah climate, with wet seasons from May to July and dry seasons from August to March[4].

Kaneshie: The area has a large central market attracting people from various places to the locality. Urbanisation is fairly low to moderate with like standard of living. Housing system is predominantly compound with close proximity between houses. Though urban in nature rapid migration and brisk economic and commercial activities in the community has resulted in most drainage systems being chocked, rendering the area flood prone. The site and its surrounding provide quite good breeding grounds for mosquitoes.

Airport West residential area: General observation reveals that residents have a high standard of living. The housing system is predominantly residential, with proper spacing and well-constructed drains.

Selection of study participants

A total of 400 participants were recruited onto the study. 200 participants each were systematically selected using every 5th patient in attendance, from the Lister Hospital, Airport West Residential area and Kaneshie Polyclinic, Kaneshie. Participants enrolled in the study, were resident in the catchment areas of interest and were of any age and gender. All participants on any form of anti-malaria therapy (prophylaxis or treatment) were excluded. Of the 400, 35 participants tested positive for malaria, 24 from Kaneshie and 11 from Airport West residential area. Informed consent was obtained from the participants and ethical clearance issued by the Committee for Human Research Publication and Ethics of the KNUST, School of Medical Sciences, Kumasi (CHRPE/SMS/KATH) and from the Lister Hospital and Kaneshie Polyclinic.

A questionnaire, prepared in the English language, was administered to each study participant. This was translated into the local languages where appropriate. The questionnaire sought to obtain information on socioeconomic factors, behavioral attitudes, housing and vector control–related parameters. Participants were made to give a brief description of their houses in terms of design, structure and other local environmental factors. This was then interpreted and categorised as excellent, very good, good and poor with reference to conditions decreasing vector lifespan and hindering malaria transmission.

Sample collection and preparation

About 0.5ml venous blood samples were collected from participants and dispensed into Ethylenediaminetetraacetic Acid (EDTA) tubes until processed. This was to enable repeated analysis of samples when the need arose. Thick blood films (TBFs) were prepared with approximately 20il of well mixed blood, stained using the Giemsa staining technique (1:10 dilution, pH 8.0) and examined by light microscopy using a × 100 magnifications[5].

Statistical analysis

Continuous variables were expressed as Mean±SD. Student t-test was used to compare continuous variables and the Fisher's exact test for categorical variables. Confidence interval of 95% was employed. P-values less than 0.05 were considered significant. GraphPad Prism (Version 5) and Microsoft Excel 2008 software were used for analysis.

Results

Prevalence and age distribution of study participants

Four hundred (400) participants were enrolled in this study. Thirty five (35) (8.75%) tested positive for *plasmodium* infection (malaria) after laboratory analysis. Of the 35, 24 (12%) were from Kaneshie and 11 (5.5%) from Airport West. This gave an average total prevalence of 8.75%. Table 1 below shows the age distribution of all study participants. The number of participants aged 0-9 were more in Kaneshie (4.5%: p=0.020) than in Airport West.

Table 1: **Age distribution of study participants**

Age (years)	Total (n=400)	Area of residence		P value
		Airport-West (n=200)	Kaneshie (n=200)	
0-9	10 (2.5%)	1(0.5%)	9 (4.5%)	0.020
10-19	37 (9.3%)	19 (9.5%)	18 (9.0%)	1.000
20-29	150 (37.5%)	78(39.0%)	72 (36.0%)	0.605
30-39	111 (27.8%)	59 (29.5%)	52 (26.0%)	0.503
40-49	65 (16.3%)	30 (15.0%)	35 (17.5%)	0.588
50-59	14 (3.5%)	6 (3.0%)	8 (4.0%)	0.787
> 59	13 (3.3%)	7 (3.5%)	6 (3.0%)	1.000

Clinical, demographic, housing and educational characteristics of study participants

Table 2 shows the general demographic characteristics of the study participants stratified by residency. The mean age of the study participants was 31.1±0.6 and this was similar to the age found in the two separate areas sampled. Of the 400 participants interviewed from both sites, *Plasmodium* infection was significantly higher amongst Kaneshie residents (12%: p=0.032) than Airport West residents (5.5%). All participants in Airport West had at least some level of education (0.0% illiteracy) whilst Kaneshie had a 17.5% illiteracy rate (p<0.001). Most of the inhabitants in Airport West generally did white-collar jobs (42.5%: p<0.001) whilst most of those in Kaneshie were self-employed (48.0%: p<0.001) and in various forms of labour, especially trading. Housing conditions existing in Airport West was better than in Kaneshie. The average number of people in homes within Kaneshie (5.2: p<0.001) was more than that at Airport West (3.7).

There was no significant difference in age, marital status, drug stock, the use of prophylactics and health seeking behaviors among the total population.

Table 2: Clinical, demographic, housing and educational characteristics of study participants

Parameters	Total(n=400)	Area of residence		P value
		Airport-West (n=200)	Kaneshie (n=200)	
Mean age (years)	31.1±0.6	31.7±0.8	30.6±0.9	0.389
MPs positive	35 (8.8%)	11 (5.5%)	24 (12.0%)	0.033
Marital status				
Single	177 (44.3%)	81 (40.5%)	94 (47.0%)	0.226
Educational status				
Illiterate	35 (8.8%)	0 (0.0%)	35 (17.5%)	P<0.0001
Basic	33 (8.25%)	8 (4.0%)	25 (12.5%)	0.003
Secondary	105 (26.3%)	34 (17.0%)	71 (35.5%)	P<0.0001
Tertiary	227 (56.8%)	158 (79.0%)	69 (34.5%)	P<0.0001
Employment status				
Formally employed	127 (31.8%)	85 (42.5%)	42 (21.0%)	P<0.0001
Self-employed	150 (37.5%)	54 (27.0%)	96 (48.0%)	P<0.0001
Unemployed	123 (30.8%)	61 (30.5%)	62 (31.0%)	1.000
Nature of housing				
Excellent	39 (9.7%)	39 (19.5%)	0 (0.0%)	P<0.0001
Very good	167 (41.8%)	130 (65.0%)	37 (18.5%)	P<0.0001
Good	137 (34.3%)	31 (15.5%)	106 (53.0%)	P<0.0001
Poor	57 (14.3%)	0 (0.0%)	57 (28.5%)	P<0.0001
Number of people in homes	4.5±0.1	3.7±0.1	5.2±0.2	P<0.0001

MP=malaria parasite; Nature of housing= Coded description of housing

Malaria knowledge, health-seeking behavior and control mechanisms

In table 3, knowledge about malaria, health seeking behavior and control mechanisms employed by the participants are shown. Residents of Kaneshie had a much lower level of knowledge about malaria than those of Airport West. Though self-medication was widespread in both communities, it was more common among the residents of Kaneshie (81.5%: p=0.004) compared to those from Airport West (68.5%). Conventional choice of treatment was preferred over herbal forms among Airport West residents (96.5%: p<0.0001) than in Kaneshie (80.5%). Participants who preferred both forms of treatment were more in Kaneshie (14.5%: p<0.0001) than in Airport West (2.0%). The people in Airport West completed their treatment courses (69.0%: p<0.0001) during malaria episodes when compared to those in Kaneshie (13.5%). The cost of treatment for a single episode of malaria was averagely higher among Airport West residents (25.67 GHμ : p=0.0004), Kaneshie (8.82 GHμ). Inhabitants of Airport West (60.5%: p<0.0001) preferred insecticide sprays as a vector control mechanism whereas those in Kaneshie (21.0%: p<0.0001) preferred the use of mosquito coils. Most people in Kaneshie (40.0%: p=0.004) did not use any form of malaria control mechanism.

Table 3: Malaria knowledge, health-seeking behaviour, choice of drugs and control mechanisms among study participants

Parameters	Total(n=400)	Area of Residence		P value
		Airport-West (n=200)	Kaneshie (n=200)	
Malaria knowledge				
Very good	196 (49.0%)	134 (67.0%)	62 (31.0%)	P<0.0001
Good	168 (42.0%)	64 (32.0%)	104 (52.0%)	P<0.0001
Poor	36 (9.0%)	2 (1.0%)	34 (17.0%)	P<0.0001
Health-seeking behavior				
Hospital/Clinic	76 (19.0%)	47 (23.5%)	30 (15.0%)	0.042
Self-medication	300 (75.0%)	137 (68.5%)	163 (81.5%)	0.004
None	24 (6.0%)	17 (8.5%)	7 (3.5%)	0.056
Drug of choice				
Conventional	354 (88.5%)	193 (96.5%)	161 (80.5%)	P<0.0001
Herbal	13 (3.25%)	3 (1.5%)	10 (5.0%)	0.087
Both	33 (8.25%)	4 (2.0%)	29 (14.5%)	P<0.0001
Drug stock	120 (30.0%)	61 (30.5%)	59 (29.5%)	0.913
Course completion	165 (41.3%)	138 (69.0%)	27 (13.5%)	P<0.0001
Prophylactic use	59 (14.8%)	31 (15.5%)	28 (14.0%)	0.778
Treatment cost (GHμ)	22.81±1.84	25.67±2.08	8.82±0.88	0.0004
Control mechanisms				
Insecticide spray	182 (45.5%)	121 (60.5%)	61 (30.5%)	P<0.0001
ITN'S	41 (10.3%)	25 (12.5%)	16 (8.0%)	0.1867
Repellant creams	3 (0.8%)	2 (1.0%)	1 (0.5%)	1.000
Coils	42 (10.5%)	0 (0.0%)	42 (21.0%)	P<0.0001
None	132 (33.0%)	52 (26.0%)	80 (40.0%)	0.004

ITN's=Insecticide treated nets; -GHμ = Ghana cedi

Demography, Knowledge, health seeking behavior and control mechanisms (Malaria Infected Individuals)

Table 4 represents the characteristics of malaria-infected participants (n=35) stratified by area of residence. More females in Kaneshie (70.8%: p=0.015) were infected compared to females in Airport West (54.5%). Infected participants in Kaneshie were mostly unemployed (50.0%: p=0.014). Kaneshie residents who used Insecticide Treated Nets (ITN's) (16.7%: p=0.008) had a higher frequency of infection than those in Airport West (0.0%) who used the same control method. There was no significant difference in educational status, drug stock and the use of prophylactics among the population.

Table 4: General characteristics of malaria infected participants stratified by area of residence

Parameters	Area of residence		p value
	Airport West (n=11)	Kaneshie (n=24)	
Sex			
Male	5 (45.5%)	7 (29.2%)	0.5634
Female	6 (54.5%)	17 (70.8%)	0.0149
Number of people in home	4.18±0.46	4.63±0.47	0.5658
Educational status			
Tertiary	7 (63.6%)	2 (8.3%)	0.5864
Secondary	3 (27.3%)	7 (29.2%)	0.8657
Basic	1 (9.0%)	7 (29.2%)	0.3732
Illiterate	0 (0.0%)	8 (33.3%)	
Employment status			
Formally employed	4 (36.4%)	0 (0.0%)	0.1531
Self employed	4 (36.4%)	12 (50.0%)	0.3321
Unemployed	3 (27.3%)	12 (50.0%)	0.0144
Nature of housing	4 (36.4%)	0 (0.0%)	"
Excellent			
Very good	5 (45.5%)	2 (8.3%)	0.8941
Good	2 (18.2%)	14 (58.3%)	0.2961
Poor	0 (0.0%)	8 (33.3%)	
Knowledge about malaria			
Very good	5 (45.5%)	6 (25.0%)	0.0926
Good	6 (54.5%)	13 (54.2%)	0.5346
Poor	0 (0.0%)	5 (20.8%)	0.5589
Drug stock	3 (27.3%)	7 (29.2%)	0.1687
Course completion	8 (72.7%)	2 (8.3%)	0.7484
Prophylactic use	0 (0.0%)	1 (4.2%)	0.2886
Control mechanisms			
Insecticide spray	8 (72.7%)	3 (12.5%)	0.6509
Insecticide treated nets	0 (0.0%)	4 (16.7%)	0.0085
Repellant creams	0 (0.0%)	0 (0.0%)	"
Coils	0 (0.0%)	6 (25.0%)	"
None	3 (27.3%)	11 (45.8%)	0.233

Discussion

This study sought to determine the most important factors that may affect malaria prevalence in two communities within an urban area. The overall prevalence of malaria from both sites was 8.75%, which was generally low. The prevalence from the individual sites took the same trend. This is contrary to a study conducted in Benin City, Nigeria which reported a total prevalence rate of 168 (34.2%) out of 491 participants[6]. In that study, Akinbo and his colleagues suggested that the relatively high prevalence may be due to poor control measures. However, in countries like Togo, long-lasting insecticide treated nets have been distributed throughout the country, reducing the prevalence rate to an appreciable level [7]. Observations made during our study revealed similar control strategies in the homes studied. This might have contributed to the relatively lower prevalence rate recorded in this study.

The finding from the current study suggests that malaria prevalence differs even within different sections of a particular area. Crompton and Savioli (1993) observed that differences in prevalence of parasitic infections are probably an indication of differences in population densities, overcrowding and unhygienic conditions[8]. The differences in prevalence between the two areas sampled in our study could also be related to the local environmental factors inherent in

each area, (for example, condition of drainage systems and overcrowding) especially at Kaneshie.

Females from both sites were more prone to malaria than males. A yet similar but contrasting study conducted in North West Burkina-Faso showed a higher prevalence in females (23.8%) than males (21.9 %) but was not statistically significant[9]. The trend in the current study however contradicts a work in the Al-Tameen province, Iraq, where more males were infected than females[10]. The high incidence of malaria amongst females in the Kaneshie community could be due to the commercial activities (mostly trading) involving early and late outdoor staying of which more females are involved.

As shown in table 2, education at all levels was significantly lower in Kaneshie than Airport West. Given that malaria prevalence was different between the two areas, is an indication that education may have some influence on the prevalence of malaria. This observation conforms to two other studies conducted along the Thai-Myanmar border area and in Egypt. These studies established the proportion of educational levels in malaria cases to be lower than in non-malaria controls [11,12]. Amongst the malaria-infected individuals the unemployed were more, contributing half the number at Kaneshie. This compares to a study in Egypt where results showed that malaria infection increases with the decrease in socioeconomic level of families and among the unemployed or students[12]. The difference in standard of living between the two groups in our study could be an indicator of the higher cost and more effective treatment of an episode of malaria among the Airport West residents. In a study conducted in Central Vietnam the wealthiest group was much less infected with malaria (8.9%) than the lower and medium income (16.6%) category[13].

Self-medication was preferred among the general population, but was practiced more amongst residents of Kaneshie. Shulman[14] observed that self-medication has become popular as a result of the creation of awareness through education on home management and control of malaria. During this study, we observed that people from both sites had adequate information on home management of malaria, especially through awareness programs organised through the media. However, the higher rate of self-medication did not reduce the prevalence of malaria in Kaneshie; a situation that contradicts an observation made by Mockenhaupt and colleagues in 2000[15], that antimalarial drugs are associated with fewer malaria parasite infections. This could be due to the fact that rampant self-medication is gradually leading to more drug resistant forms of the *Plasmodium* parasite, reducing drug effectiveness in most cases.

A greater number of Airport West residents visited the hospital more than their counterparts from Kaneshie. This could be due to differences in income levels and therefore the ability to afford effective malaria treatment. This is in agreement with an observation made by Adams and colleagues[16]. They suggested that poor people are at an increased risk of malaria infection and death and are also less likely to be able to pay for effective malaria treatment and/or transportation to a health facility. In the report, reference is made to a study in the Kassena-Nankana District in the Upper East Region of Ghana, where the cost of malaria care was 1% and 34% of the income of the rich and poor respectively[16].

The control methods used in both sites differed greatly. This may be attributed to the difference in the standard of living in these areas. This compels most of the occupants of Kaneshie to use coils and other cheaper forms of mosquito control[16].

Conclusion

Malaria prevalence differs within different communities in the same urban area. Considering the differences in prevalence, the following factors; age, education, employment, number of people in a home, health seeking behavior, compliance to treatment, control mechanism and standard of living may influence malaria prevalence. To enhance the fight against malaria new tools and techniques are still needed. There is thus need for community-centered control, community involvement and education especially in areas with low levels of education and urbanization.

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