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EVALUATION OF MALARIA INFECTION IN RELATION TO AGE AND RESIDENTIAL AREA IN NANDI COUNTY, KENYA
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ABSTRACT

***Objective*: To investigate malaria infection in relation to age and residential area.**
***Design*: A cross sectional study.**
***Setting*: Kipsamoite Dispensary of Nandi County in Kenya.**
***Subjects*: The demographic details and medical history for all consenting patients was taken by the clinical officer/nurse.**
***Intervention*: Clinical examination was done followed by presumptive diagnosis for clinical malaria.**
***Main outcomes*: A total of 349 patients were examined and tested for malaria during the period under study.**
***Results*: Whereas infection distribution was significantly associated with age groups $P<0.05$ ($\chi 2 = 4.190$); no significant difference in mean parasite density distribution over the seven residential area categories ($P = 0.261$) ($F = 1.305$) was found.**
***Conclusion*: Patients aged > 5 years were found to be infected more than those aged <5 years. On overall, there is a need to start targeting patients above five years of age and encourage them to access malaria control interventions especially the use of insecticide treated bed nets to minimise their infection rate.**

INTRODUCTION

Malaria continues to be a major public health problem in Kenya accounting for 30% of outpatient hospital attendance nationally and 19% of all admissions to health facilities of which 5% die (1). This is so given that the level of its endemicity in Kenya ranges from hyper-endemic to holo-endemic areas at the coastal and lake regions respectively. Unstable cases of malaria also occur in several areas which include Kajiado, Narok and arid and semi-arid areas (2). Epidemic malaria occurs mostly in western Kenya highlands, which include Kisii, Nyamira, Trans-Nzoia and Nandi Counties (3).

The number and species of Anopheline mosquitoes are known to determine to a large extent the level of transmission in a given area. But more so, malaria transmission is influenced by climate and often increases after the onset of the rainy season (4), when breeding sites are available for mosquito breeding. Other studies have found out that population movements is a contributory factor to the spread of malaria and movement of infected people from areas where malaria is endemic to areas where the disease has been eradicated often led to the resurgence of the disease (5). Deforestation for resettlement and creation of irrigation schemes has long been indicated to increase the risk of transmission (6). Some researchers have observed that malarial disease occurs at high frequency and varies in relation to age and space (7). However, what is not known is whether the malarial infection is both age and residential area specific or not. This study sought to find out malaria infection in association to age and residential area.

MATERIALS AND METHODS

This study was carried out at Kipsamoite Dispensary in Nandi County in Kenya. The clinical officers/ nurses were used to take the demographic details and medical history for all consenting patients before doing clinical examination. Malaria case was defined as clinical episode of illness in a person with fever or recent history of fever with/without other signs and/or symptoms of malaria (8). All cases diagnosed as clinical malaria were referred to the laboratory for confirmatory tests.

Parasitological examination was done by use of both thick and thin blood films which were stained with 3% Giemsa solution for one hour. The slides were air dried and examined under compound light microscope using x100 objective. Malaria infection in patients was defined as those who had parasitological confirmed results (9). Parasites, if any, were counted against leucocytes in each microscopic field until 200 leucocytes were counted. A slide was considered negative after 100 microscopic fields were examined without identifying any *Plasmodium* parasites. A standard closed ended questionnaire was administered to the mothers/caretakers/patients.

RESULTS

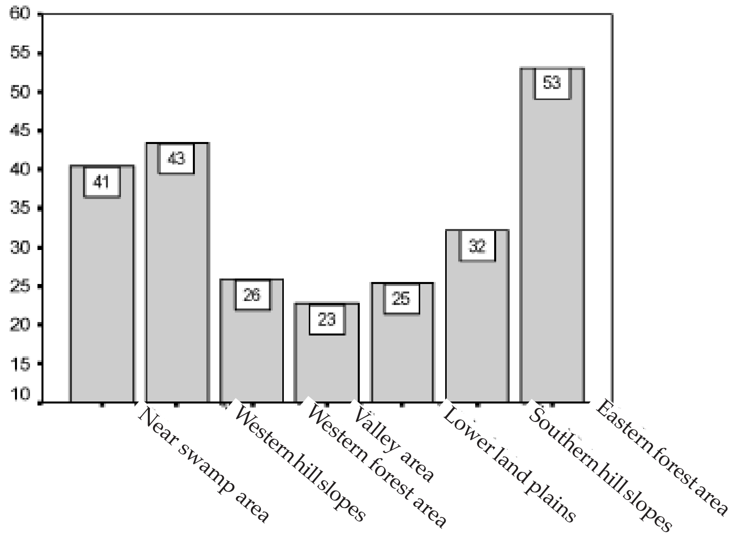
A total of 349 patients consented to this study and were enrolled. All the 349 patients gave their actual ages. In the age group <5 years 27/109 (24.8%) were infected with malaria while 82/109 (75.2%) were negative for malaria by microscopy. In the age group > 5 years 86/240 (35.8%) were infected with malaria while 154/240 (64.2%) were negative (Table 1). The infection distribution was significantly associated with age groups $P< 0.05$ ($\chi2 = 4.190$).

Table 1
Distribution of malaria infection by age groups

Age group	Microscopy results		Prevalence	Total
(years)	Positive	Negative	(%)	
<5	27	82	24.7	109
>5	86	154	38.5	240
Total	113	236	32.4	349

Distribution of malaria infection among patients analysed according to residential areas showed slight variation. The village located in proximity to Chepyewet showed malaria infection in 32/79 representing 41% prevalence. The population living at the eastern hill slopes of Kipsagat showed malaria infection in 10/23 representing 23%. The Eastern forest village of Moraongen showed malaria infection in 21/81 representing 26% while the Northern hill slopes of Kipsamoite had 10/31 representing 32.2% of malaria infections. The villages within the area of the valley of Kwidich and Kapkweino showed malaria infection of 10/44 representing 23% while the village situated in the lower land plains of Kapkuto showed malaria infection of 15/59 representing 25% of the cases and the village situated towards the western forest area of Kamwega showed malaria infection of 17/32 representing 53% (Figure 1). The results showed that the distribution of malaria infection was not dependent on residential villages. Overall, there was no significant difference in the distribution of malaria infection among these seven residential areas.

Figure 1
Distribution of malaria infection within residential areas



The malarial parasite density was zero for the 236 patients representing 67.6% of those who tested negative for malarial infection using microscopic diagnosis. Those patients with detectable malarial infection had the following ranges of parasitaemia: 24 patients representing 16.9% had < 100/ 200 WBC parasitaemia, 14 patients representing 4% had 101-200/ 200 WBC, nine patients representing 2.6% had 201-300/200 WBC, six patients representing 1.7% had 301-400/ 200 WBC. Furthermore, six patients representing 1.7% had 401-500/ 200 WBC, seven patients representing 2% had 501-600/ 200 WBC, nine (2.6%) had 701-800/ 200 WBC, another seven representing (2%) had 801-900/200 WBC and thirty representing (8.6%) had >900/ 200 WBC. The highest parasite density was recorded in the residential area located near the swampy area (Chepyewet village) while the lowest parasite density was observed in the village situated in the western forest area called Kamwega. Significantly, many patients had parasite densities of > 900/200 WBC ($\chi 2$ = 349, df = 102, P=0.0001). Parasitaemia distribution was independent of the patients' location (Table 1).

Table 2
Parasitaemia in relation to residential area
Log parasite density

Residential area	Minimum parasite density	Maximum parasite density
Near swamp area	2.8	5.7
Eastern hill slope	3.2	4.9
Eastern forest area	2.2	5.4
Valley area	2.5	5.2
Lower land plains	2.6	4.9
Northern hill slopes	2.8	4.8
Western forest area	2.7	4.5
Total	2.2	5.7

Parasite density distribution based on analysis by one way analysis of variance (ANOVA) revealed that there was no significant difference in mean parasite density distribution over the seven residential area categories (P = 0.261, F = 1.305).

DISCUSSION

The results of study revealed that malarial infection ranged from 0% to 35.8 % among those aged > 5years and 0 to 24.7 % among those aged < 5 years. The infection distribution was significantly associated with age groups ($P < 0.05$, $\chi2 = 4.190$). This finding is a departure from observations by Svenson and others (10), who when comparing the groups with severe and non-severe disease, found that age was not a significant contributing factor to severity. However, other studies have noted higher prevalence of malarial infection among children aged one to four years (11).

The lower prevalence of malaria infection among children less than five years of age could have been attributed to preference by parents and caregivers to protect their children with insecticide treated bed nets which had been introduced by the Government of Kenya through Ministry of Health after the post Elnino malaria epidemics in Western Kenya highlands between 1998-2000. The implementation of such intervention had not reached wide scale accessibility during the study period and this could have been the major reason why parents/caregivers could have prioritised the protection to the children following their experience of deaths in the past epidemics.

In Kapsamoite, older age had been associated with reduced risk for malarial infection (12). Other researchers have observed a positive association of malaria severity and age (13). However, other investigations have revealed that mortality from malaria is highest in the youngest (<2 years) and oldest age groups (>40 years), 2.2% and 2.5%, respectively, compared with 0%–0.9% for patients who were 2–40 years of age (14). The possible explanation for the high prevalence of infections reported in this study for adults suggests that these persons being from the highlands are likely to have passive or no immunity. Lack of adequate protective measures such as long lasting insecticide treated nets (LLINs) among the group aged above five years could be another contributing factor.

Participants in this study were drawn from seven different residential areas that are located in different topographical zones. Malarial prevalence ranged from 23% observed in Kakweino/Kwindich, located in the valley area to 53% in Kamwega situated to the western forest area. This distribution was however not dependent on residential villages ($P = 0.149$). This data suggest that topographical zone and climatic ecosystems could have been false. The observed distribution could be attributed to the fact that all residential areas fall within the same transmission pattern.

The prevalence of malaria in the highlands of Eastern Africa has been shown to vary spatially and temporally as a result of seasonal variation and topography (14). The topography of the highlands comprises hills, valleys and plateaus. Rivers and streams flow along the valley bottoms in the valley ecosystem and swamps are a common feature. Unlike in lowland plains, where drainage is poor and mosquito breeding habitats have an extensive distribution, the majority of breeding habitats in the hilly highlands are confined to the valley bottoms because the hillside gradients provide efficient drainage (16). The non-homogeneous distribution of larval breeding habitats is likely to affect adult vector spatial distribution and may, consequently, lead to focal malaria transmission and heterogeneous human exposure to malaria. Some researchers observed in the same area that nearness to swamp and forest are risk factors for malaria infection (12). This concurs with the current study findings which indicate that both residential areas (Chepyewet and Kamwega) as having higher prevalence rates of infection as compared to the rest of the villages. The malaria immunity profile in the highlands is likely to be influenced not only by age, but also by distance from the foci of transmission. Other studies have also reported similar findings (17; 18). The pattern of malaria transmission in the highland plateau ecosystems may be less distinct due to the flat topography and the more diffuse hydrology resulting from numerous streams.

In summary, there was a significant correlation between malaria infection and age of patients attending Kipsamoite dispensary. The patients aged five years and above were more infected with malaria than those aged less than five years. This may require a change in tactic by the stakeholders such that patients above five years of age are also targeted and encouraged to access malaria control interventions especially the use of insecticide treated bed nets to minimize their infection rate.

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