SEASONAL DISTRIBUTION OF MOSQUITO TRANSMITTING MALARIA, AND THEIR MALARIA PARASITE INOCULATION RATES IN THE LOWLAND AND HIGHLAND AREAS OF MUHEZA DISTRICT, TANGA REGION NORTH-EASTERN

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Introduction

The entomology inoculation rate (EIR) is one the main transmission indicators used in epidemiological studies to estimate the intensity of malaria transmission in a certain area. Indeed, EIR reflects the level of a risk of exposure to the infective bites of mosquitoes in a community at any given time, a person living in a malarias areas would expect to get. Estimation of EIR depends, on the accurate assessment of the proportion of the mosquito vector population harboring infectious sporozoites, and the number of vector mosquitoes coming to feed on human each night. Salivary gland dissections and enzyme immunoassay (ELISA) are the only techniques used so far to measure the proportion of infectious mosquito population.

Muheza district is an area holoendemic for malaria transmission, morbidity and mortality among the under five year's children. The area is perhaps one of the few districts in Tanzania where extensive malaria related researches have been carried out for more than four decades hitherto. Recently there has been a growing interest in studying malaria in the highland of Muheza. It is therefore the objective of this paper to make a comparative examination of the pattern of EIR between the highland and lowland area of Muheza district.

Study Area

Muheza, which is 35km from Tanga, is one of six districts in Tanga region. Topographicaly the district is divided into hot and humid lowland (c.200m from sea level), and cool and wet weathered highland (900-1200m above sea level). Malaria transmission in the lowland is perennial. However, malaria transmission is seasonal in the highland.

Material and Methods

The mosquito specimen used for analysis was collected from on going study in Muheza, which tries to determine the effect of long-term vector control (using ITN) on anti-malaria antibodies in the area. The collections were done on monthly base from August 1998 to March in 1999 in eight and eleven hamlets in the lowland and highland area respectively ,using light trapping method of Lines *et al,* (1991) in eight designed bedrooms in every hamlet. A sandwich Enzyme-Linked Immunosorbent Assay (ELISA) technique (Burkot *et al,* (1984) was followed to test mosquito specimens for *Plasmodium falciparum* circumsporozoites. By using the relationship of light trapping and human bait collection methods as suggested by Lines et *al.,* (1991), the EIR was calculated as follows:

E.I.R. = 1.5x (mean number of female *Anopheles*/light trap) x CSP positive x sampling time. Results obtained were statistically analyzed using STATCALC of EPI info software.

Results and Discussion

A total of 4 554 Anopheles mosquitoes were analyzed for *P.falciparum* circumsporozoite protein (CSP) out of which 2300 and 2254 were from highland and lowland hamlets respectively.

Data analysis was done by seasons, namely August to November 1998 and December 1998 to March 1999. Three out of eight-*Anopheles* mosquito species collected were found to harbor infectious sporozoites. This included complexes of *An. gambinae, An. funestus, An. marshalli. An. funestus* was the predominant vector caught in the highland in both seasons (46% and 50% respectively)). However, in lowland a different pattern was observed whereby members of *An. funestus* were the most abundant (73.6%) in the first season (August-November 1998) and An. *gambiae s.l.* predominated (94.1%) in the second season (December 1998 to march 1999) The indoor population density of this nature agrees with other observation done elsewhere, that *An. gambiae s.l. An. funestus and An. marshallii* are more endothermic and endophilic in behavior than other anopheline species found in the study areas (Wilkes *et al.,* 1995, Mnzava and Kilama,1986). The three species almost displayed a relative constant peak fluctuation with rainy seasons throughout a year as it has been observed by Gillies and Coetzee. (1987).

It could further be argued that the climatic conditions were the main attributable factors to the relative abundance of members of *An.gambiae s.l.* and *An.funestus* over two sampling seasons. Members of *An. funestus* prefers to breed in water bodies with highest degree of shading, conversely, *An. gambiae s.l.* are fond of open sunlit water bodies. The former type of environment prevails for much of the time in the highland areas and towards the advanced stage in the rainy season in the lowland. The conditions, which favor population growth of *An. gambiae s.l.*, are more prevalent in the lowland. This seems to be the explanation for the observed high population density of *An. funestus in* both seasons in the highland, and the first season in lowland hamlets; and *An. gambiae s.l.* is highly populated in the second season in lowland.

Pooled data for species did not reveal any significant difference in the number of mosquito's population with infectious sporozoites in both study areas. 3.6% (78) and 3.3% (47) of the total mosquitoes collected from lowland and highland respectively were found to harbor infectious sporozoites.)While *An.funestus* accounted for significant higher CSP positive rates in highland hamlets (3.76%) in the period between Aug-Nov' 98, *An. gambiae s.l.* took a lead in the lowland (6.96%). However, there were no significant differences between the two species in the period between December 1998-March 1999 in both study sites. In both study area members of *An.gambiae and An.funestus* were the most efficient vectors in transmitting in both seasons.

($A^2=1.47^{M-H}$,p=0.225). Altitude and environment changes can influence disease by effecting how the mosquito vectors behave or survive. In the past cold climate in East Usambara highland hindered natural growth of mosquito vectors and parasite development in them, thus making malaria transmission to be very insignificancy in this area. However, the situation has now changed; more cases of malaria are being reported (see for example Fowler, VG *at al,* 1993). This is partly attributable to topographical modification emanated from human activities. The expansion of farms for cultivation and livestock keeping, and massive harvesting of trees for timber industries. In this way many more breeding ground for mosquito vectors have been created and as a consequence a natural parasite development in them (see for example a study by Ell man *et al.*1998). Massive consumption of Chloroquine in 1960s followed by emergence resistant parasites of the mosquito vectors in the areas study (Lines et al. 1991).

There were significant differences in the level of pooled EIR between species. Pooled EIR in the highland for the months of August - November 1998 was 5.64 with *An.funestus* being the highest (EIR estimates of 4.85). Pooled EIR estimates for the months of December 1998-March 1999 was 11.54, with *An.funestus* again remaining at the top by accounting for the highest EIR estimates of 66.5. Pooled EIR estimates for the months of November 1998-March 1999 was 129.4 with *An. gambiae* dominating the contribution by accounting to an EIR estimate of 122.4. The pooled EIR estimates in the lowland hamlets by all species in that eight sampling months was 226.3. This estimate is approximately 13 times higher than that of the highland hamlets. The differences in observed EIR estimates suggested that people living in the lowland hamlets were at risk of exposure to infection at least 13 times more than their counterparts in the highland. High EIR estimates are a common scenario in the lowland Muheza. The association between high EIR estimates and frequent malaria fever episodes in people living in the lowland Muheza have somehow been explained. Msuya and Curtis (1991), suggested that infections EIR estimates suggested that super infections (i.e. several malaria infections at once) caused by high exposure to malaria infections could lead to such phenomenon.

EIR estimates suggested that the months of December 1998 to March 1999 had higher transmission rates than August-November 1998. Cost-effective vector control measures like wide use of impregnated bed net (ITN) is therefore, advocated to be used to reduce the risk of acquiring infection in both study areas. Clear evidence for mass effect of ITN use on EIR (i.e. mass lolling effect on mosquito population) has been shown in village scale trials in the lowlands (Magesa *et al,* 1991), and on incidence of re-infection after clearing existing infection (Msuya and Curtis, 1991). Moreover, in order to reduce the intensity of morbidity and therefore unbearable suffering in people living in such areas, it is therefore suggested that more antimalarial drugs should be allocated to the remote areas where the study was carried out during the peak malaria transmission (December-March). This could be in line partly, with the current WHO malaria control policy, which directs people living in malaria endemic areas to have an early diagnosis and prompt adequate treatment whenever shown symptoms of clinical malaria.

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