Original Articles

Mosquito Vector Biting and Community Protection in a Malarious Area, Siahoo District, Hormozgan, Iran

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Abstract

Background: Use of bed-net continues to offer potential strategy for malaria prevention in endemic areas. Local communities are indispensable during design and implementation stages.

Methods: A cross-sectional study of 192 randomly selected inhabitants was carried out in malarious zone, Siahoo direstrict, Hormozgan Province, southern Iran. In addition, we monitored human landing periodicity of main malaria vectors and as well as self-protection of inhabitant in the study area for a period of one transmission season between April to October 2006.

Results: The biting activities were seen throughout the whole night for three malaria vectors, *Anopheles fluviatilis*, *An. stephensi* and *An. dthali*, and *An. fluviatilis* exhibiting bimodal peaks, the first at midnight (0:00−1:00) and the other before dawn (5:00−6:00 am) but the maximum biting activity of *An. stephensi* was occurred at second quarter of night (11:00−12:00 pm). The majority of interviewers (83.3%) knew that malaria was transmitted by mosquitoes and 70.3% of them stated that bed-net is the best control measures. Most subjects (62%) did not have a mosquito net.

Conclusion: Study subjects were aware of an association between mosquito bite and malaria transmission. Health workers at different levels of the health care delivery system should disseminate relevant information about self-protection to help community members to be involved more in malaria control.

Keywords: Malaria, Community Protection, Mosquito Bite, Iran

Introduction

In spite of more than 45 yr malaria control programming, malaria remains prevalent in southern and southeastern Iran. During the last six yr, 15000 to 25000 cases have been reported each year in Iran and more than 85% of them occurred in the south and southeast of the country (Department of communicable Disease Control, personal communication). The annual parasite index (API) is seven per 1000 inhabitants in the endemic area (Raeisi 2006). Several factors, such as presence of insecticide resistance among vectors (Dinparast-Jadid et al. 2006), parasite drug resistance (Edrissian et al. 1993, Edrissian 2006) and socio-economical problems (Banguero 1984, Raeisi 2006), have made eradication in this area impossible. However, several main inhibitor factors have been defined in Hormozagan Province, which restricted malaria control programs in that particular area (Masoumi Asl et al. 2003). Generally, prevention of malaria through better knowledge and awareness is the appropriate way to keep malaria disease away. In addition, knowledge of host feeding pattern

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and resting behavior of mosquito vectors are important for understanding the host-vector relationship and dynamic of disease transmission and for development of control strategies (Singh 1998, Chaves et al. 2010).

The predominant mosquito species in the southern Iran are *Anopheles stephensi*, *An. culicifacies* and *An. fluviatilis* which play the major role in malaria transmitting (Zaim et al. 1993, Vatandoost et al. 2003, Basseri et al. 2008). Vector control activities in south and southeast of Iran are mainly restricted to indoor residual spraying (IRS) in selected endemic localities with pyrethroids and larviciding with *Bacillus thuringiensis*, (Ministry of Health and Medical Education, Iran 2008). In addition recently by planning malaria elimination program, self-protection using bed net has been more considered.

With this background, this study is proposed to find the sleeping behavior of resident and the ratio of man-vector contact in the area where exophilic vector such as *An. fluviatilis* is highly active and therefore using indoor residual spraying is so limited. Although, it has been planned to used long lasting Impregnated bed net in south of Iran by health authorities in local provinces, therefore, the results of this study can show more strengthens and weakness of using bed net in that particular area.

Materials and Methods

Study area

This study was performed in Siahoo district located in about 90 km north of Bandar-Abbas city, Hormozgan Province (25°24'–28°57 'N and 52°41'–59°15' E) over a period of six months, during 2007 and 2008. The temperature reaches to maximum 35° C in highlands and to 40° C in plan areas during summer but it rarely decline to 5-10° C during winter. Generally, the area has a subtropical climate and is prone to seasonal malaria transmission. Hormozgan comprises three regions of differing geography, the coastal region in the south, a mountainous region in the north, and a rural plateau or plains region in the centre. Siahoo is a rural county located in mountainous area with a total population about 10000. It is an agricultural region irrigated by rivers, deep wells, and cement pools, which are the main of breeding sites for mosquitoes. The annual rainfall ranged from 80 to 100 mm. Features contributing perennial transmission in the areas are mainly due to population movement and specially form west border of province, Sistan-Baluchistan. The malaria vectors are very much potent with high anthropophilic index and frequent man biting habits and above all presence of varying degree of resistance to insecticides and drugs.

Sampling technique

A cross-sectional study was designed for the study area. Ten percent of target groups including residents, who attended to malaria clinics in Siahoo Health Centers, were selected by systematic random sampling. Then they interviewed to obtain knowledge, attitude and behavior of them about mosquito biting and self-protection against it and malaria transmission. Structure interview forms were obtained from participants. The structure interview form was explained to local staff in advance. The completed forms and records were then checked and collected by technicians at the Health Research Center of Bandar-Abbas (Institute of Public Health, Tehran University of Medical sciences).

Data Collection; methods, instruments used, measurements:

Structure questions consisted of open and closed questions and designed in several parts, including participants' details, house structure, sleeping behavior, mobility, self-protection, history of malaria infection and treatments used, facilities, access to health services. The interviews were conducted in the native accent and dialects by questioners. The validity of

questions was checked in Statistics Department, School of Public Health, and Tehran University of Medical Sciences. Data were analyzed under supervision of the Statistics Department, School of Public Health.

Ethical approval for the research was obtained from the Tehran University of Medical Sciences research Ethics Committee. Informed consent was obtained from all participants themselves. Anonymity was assured to the participants, and it was explained to them that transcripts would not have identifiable features and would be kept in a secure location.

Mosquito collection (mosquito landing catch)

Activity of malaria vectors was surveyed by human landing catch by interval two weeks during seasonal activity of mosquitoes, from 10th of April to 20th of October 2006. Human landing catch was carried out continuously during whole night from sunset since sunrise (19:00–06:00 h) by trained staff using oral aspirators (Service 1976). Two human volunteers of native people acted as baits while wearing their normal clothing. The exposed body surfaces were searched and the mosquitoes that were attempting to bite were collected using oral aspirators by insect collectors. During human landing collection, collector workers shift every two hours. The hourly collection of mosquitoes were kept and brought to laboratory alive. They were anesthetized by chloroform and identifies based on species keys of Smart (2003). Finally, the human biting rate was calculated directly from human landing catches as the average number of bites per person per night.

Results

Demographical information and knowledge of respondents

In this study, the valid questionnaire was 192 respondents. The mean age of subjects was 31 yr (range 12 to 69 yr; standard deviation 11 yr; median 30 yr). Near one third of respondents were females and totally, less than one-fifth (19.2%) of participants were illiterate. The demographic characteristics of the interviewees are showed in Table 1.

Mosquito bite was mentioned to be the main 'cause' of malaria by 83.3% of the respondents. Other mentioned causes were dirty water (10.9%), and food (0.5%) and 3.6% of respondents said they do not know (Table 2). When asked about the ways of preventing malaria, 70.3% recognized using mosquito nets, 89% drying stagnant water around their homes, 4.2% using screens on doors and windows and 68.7% insecticides as control measures.

Practice for biting protection

Majority of respondents (62 %) reported that not having bed net. Generally, all respondents with bed net indicated that they used bed nets more often from beginning of April to end of September but them majority of them used nets from evening and night and only 4.1% of those who owner of bed net, used it during whole night (Table 3). Near 40% of total interviewers stated that they always used bed-net and only a few of them sometime slept under bed-net. The majority of respondents do not have mosquito screen on windows (75%) and doors (99%).

Mosquito biting periodicity

Biting activities of the mosquito vectors are shown in Fig. 1. *Anopheles fluviatilis, An. stephensi* and *An. dthali* were highly active during whole night. The mosquitoes started biting continuously from sunset to sunrise (Fig. 1). *Anopheles fluviatilis* was predominantly captured on human baits followed by *An. stephenis* and *An. dthali* at relatively lower population. Landing rate of *An. fluviatilis* with average of 11.2 mosquitoes per human bait per night was slightly higher than others were. The average number of *An. stepehnsi* captured on human bait per night was 4.1 and for *An. dthali* was 1.5. The peaks of landing for *An. fluviatilis* and *An. stephensi* was

occurred at approximately midnight followed with a short peak before sun rise but *An. dthali* started landing earlier at begging of sunset and its activities declined at midnight.

Table 1. Main demographic characteristics of the study sample (participants)

Characteristic	No.	%
Age (years)		
<15	18	9.4
16-25	63	32.8
26-45	81	42.2
46^{+}	30	15.6
Sex ratio		
Males	125	65.1
Females	67	34.9
Education level		
Illiterate	31	16.1
Literate	161	83.9

Table 2. Knowledge of participants about transmission route and control measures

Variable	Frequency	%
Route of transmission		
Mosquitoes	160	83.3
Dirty water	21	10.9
Polluted food	1	0.5
Other incorrect	3	1.6
Don't know	7	3.6
Control measures		
Using mosquito net	135	70.3
Using door/window screen	8	4.2
Taking drugs regularly	10	5.2
Drying stagnant water	171	89.0
Using insecticides	132	68.7
Others	22	11.4

Table 3. Mosquito biting behaviors practiced by participants

Variable	Frequency	%
Availability of mosquito net		
Have mosquito net	73	38.0
Frequency of net use		
Always	65	33.9
Sometimes	8	4.1
Time of net use		
Night	27	14.0
Evening and night	46	24.0
Use of screens		
On windows	25	13.0
On doors	1	0.5

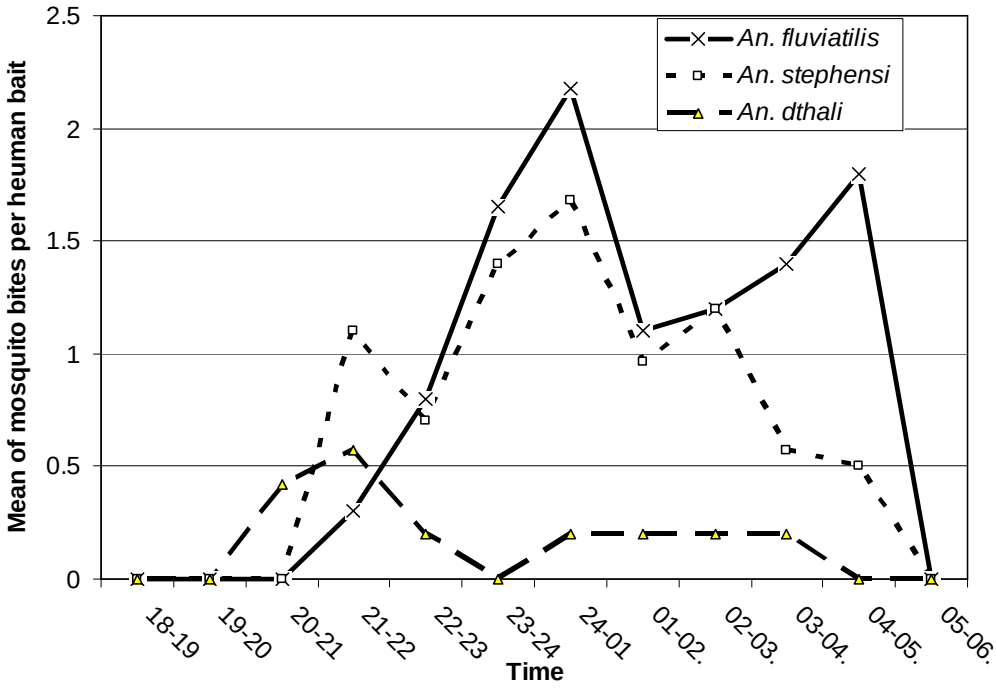

Fig. 1. Biting activities of main malaria vectors during night on human bait in Siahoo district, Hormozgan.

Discussion

Although the ratio of literacy among participants was relatively high, it is necessary to provide people with adequate information about the role of mosquito vectors in transmission and incidence of malaria in their area and its complications, to increase public awareness about the importance of malaria vector. However, the study revealed that in Siahoo, community comparatively recognized the role of mosquitoes in malaria transmission and knowledge of malaria was moderate but the malaria prevention activity by people was relatively poor. Nevertheless low level of educational status, rampant ignorance about the cause, treatment, and prevention of malaria, poor socio economic background contributes a lot to the cause of malaria but fortunately, adequate health care services can make the disease infection declined in the region (Banguero 1984).

The biting behavior of any mosquito species is a biologic characteristic and could vary among species. The biting activities of *An. fluvialitis* and *An. stephensi* were seen throughout the whole night from dusk to dawn. Thus, the residents in Siahoo region are exposed to the vector bites even before bedtime or using bed-net. *Anopheles fluvialitis* and *An. stephensi* are principal vectors in south slop of Zagrus mountain chain (Manouchehri et al. 1976, Vatandoost et al. 2006). *Anopheles fluvialitis* has been recognized as a wild malaria vector with high anthropophilic index (Nanda 2000, Basseri et al. 2005). In contrary, *An. stephensi* is a domestic mosquito with endophilic and endophgic behaviour in Hormozgan Province (Vatandoost et al. 2006). In the present study, *An. fluviatilis* was predominant among the mosquitoes collected in the human landing catches. Controlling of this species is ecologically and logistically challenging. The options for the control of this species are very limited but self-protection methods such as using insecticide integrated bed-net could be more convenient way to control malaria transmission. In addition, human-vector contact could be reduced by a adjusting the time of bed-net use (Binka 1998). Thus insecticide integrated bed-net can be targeted approach of adopting personal protective measures in Siahoo area while *An. fluviatilis* avoid feed or resting in indoor places (Edalat 1998). However, these measures need to be encouraged among the native population (Stephens 1995). They could be sensitized and motivated by health workers to adopt such measures. The key to implementation of personal protective measures are health education and socioeconomic development, which can cause the annual infective biting rate and reduce transmission potentials.

We conclude that the biting periodicity of *An. fluvialitis* is bimodal peaks and the peak biting activity of this mosquito coincides with the sleeping time of inhabitant. The risk of acquiring an infection based on parity status could be elucidated towards the dusk since dawn hours, as shown by the bimodal peaks of biting activity of mosquitoes, namely, a minor peak at midnight. Therefore human-vector contact could be reduced by a time and space targeted approach of adopting personal protective measures such as protective (Yadav et al. 1999, Takken 2002).

In conclusion, regular and periodic intervention in the form of health education to bring an attitudinal and behavioral change and provision of better health care services in the Siahoo area can bring qualitative change in control of malaria in the region.

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