Research Paper

J. Med. Sci., 5 (4): 298-302
October-December, 2005

Climatic Changes and Natural Population of *Anopheles* Species in Quetta Valley

Arsala Mansoor

An entomological study of *Anopheles* species was conducted to find the seasonal variation of prevalent vectors to establish their correlation with the malaria parasite in Quetta. Vector collection was done according to World Health Organization standards of surveying. Analyses reveal the predominantly rapid increase in density of *Anophles stephensi* in rural areas, over *Anophles culicifacies*. The changing pattern of vectors in rural area must be due to some strong factor, which could obviously be attributed to the migration of million of Afghan refugees living mostly in the suburbs of Quetta.

Key words: *Anopheles*, natural population, parasite, seasonal variation, Afghan refugees

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original articles in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued four times per year on paper and in electronic format.

For further information about this article or if you need reprints, please contact:

Arsala Mansoor
Department of Biotechnology and Informatics,
Balochistan University of Information Technology and Management Sciences,
Quetta, Pakistan

ANSInet
Asian Network for Scientific Information

Department of Biotechnology and Informatics, Balochistan University of Information Technology and Management Sciences, Quetta, Pakistan

INTRODUCTION

Malaria is transmitted and spread naturally by the bites of a few species of infected female mosquito which belong to the genus *Anopheles*. Amongst the 400 known *Anopheles* species, only sixty of them are known to feed on man[1]. There are twenty two species; one variety and two sub-species of *Anopheles* recorded in Pakistan, but only few are considered as vectors[2]. Out of 22 species of *Anopheles* of Pakistan, a maximum of twelve species are present in Balochistan, two of which are most abundantly and widely distributed and are the known vectors, *Anophles culicifacies* (*A. culicifacies*) and *Anophles stephensi (A. stephensi)*. The other two *A. annularis* and *A. subpictus* have a restricted distribution and low density, while *A. multicolor, A. nigerrimus, A. superpictus, A. dthali* and *A. turkhudi* are rarely found[3]. The last three of them were found to be abundantly present in Quetta till 1959, while *A. superpictus* was a confirmed and most dangerous vector[4]. Unluckily, not much data is available on the entomological studies of malaria in Balochistan, except the routine collections done by Malaria Control Center.

In the present studies efforts have been made to find the seasonal variation of the prevalent vectors in Quetta valley. Comparison with the previous record of Malaria Control Center was accomplished and was statistically analyzed to confirm the intensity of resurgence of malaria in Quetta city.

MATERIALS AND METHODS

Vector collections were made monthly from four specially selected catching stations scattered over Quetta rural and Queta urban. Each of the four areas lies within the agricultural drain of Quetta valley, which provides an excellent breeding site for *Anopheles* mosquito. Two sites on Quarry Road and Satellite Town were selected from Quetta city, while the third and fourth one was from the rural area, i.e. interior of Sabzal Road. Numbers of rooms checked were according to the World Health Organization standards for surveying, which includes two animal rooms (sheds), two store rooms and one living room. Samples were taken from such structures, both from the proper city and from the suburb areas, which were close to the breeding sites. Mosquito collection in these indoor resting sites was conducted from January 1992 till December 1994. The resting mosquitoes were collected in morning for thirty minutes in each, structure. Mosquitoes were placed in screened pint cartons and kept in insulated boxes for transport back to the laboratory for identification[5].

Environmental temperature was recorded concurrently with each collection and was confirmed from the Metrological department Quetta. Rainfall record and humidity records were kindly obtained from the Metrological Department, Government of Pakistan.

RESULTS AND DISCUSSION

This is the first kind of three year entomological evaluation ever done in Quetta valley, which compares the vectors of Quetta urban and suburbs (Table 1-3). The seasonal appearance or disappearance of *Anopheles* species is correlated with the help of graphs with fluctuation in temperature (Fig. 1-3). Humidity or rainfall is also shown at the same time to establish a relation between the meteorological conditions and the vector density. The most prominent thing observed from the results is the common pattern of appearance of the *Anopheles* species. *A. culicifacies* appeared mostly in April or May and increased greatly in June July and a decline starts in September. This shows that *A. culicifacies* is not resistant to low temperatures. *A. stephensi* appears a little later and do not increase rapidly until July. It is found in maximum number in August and September and in November becomes quite scarce. This shows the monomodial pattern of the vectors in Quetta. Their appearance or disappearance could be correlated to temperature only. During the months of June, July and August higher humidity and rainfall does

Table 1: Total density of the vectors *A. culicifaces* and *A. stephensi* in Quetta in 1995

Locality*	Months	Mean No. of *A. culicifacies*	Mean No. of *A. stephensi*
Rural	January	0	0
Urban		0	0
Rural	February	0	0
Urban		0	0
Rural	March	2	0
Urban		0	0
Rural	April	2	0
Urban		1	0
Rural	May	18	1
Urban		2	0
Rural	June	36	2
Urban		3	3
Rural	July	38	16
Urban		3	4
Rural	August	23	25
Urban		2	5
Rural	September	4	13
Urban		2	4
Rural	October	1	2
Urban		0	2
Rural	November	1	0
Urban		0	0
Rural	December	0	0
Urban		0	0

*Each locality of rural and urban represents two sites of collection

Table 2: Total density of the vectors *A. culicifaces* and *A. stephensi* in Quetta in 1996

Locality*	Months	Mean No. of *A. culicifacies*	Mean No. of *A. stephensi*
Rural	January	0	0
Urban		0	0
Rural	February	0	0
Urban		0	0
Rural	March	0	0
Urban		0	0
Rural	April	0	0
Urban		1	0
Rural	May	5	0
Urban		2	0
Rural	June	15	5
Urban		3	3
Rural	July	24	12
Urban		4	8
Rural	August	28	15
Urban		2	5
Rural	September	8	6
Urban		1	5
Rural	October	18	3
Urban		1	2
Rural	November	2	0
Urban		1	0
Rural	December	0	0
Urban		0	0

*Each locality of rural and urban represents two sites of collection

Table 3: Total density of the vectors *A. culicifaces* and *A. stephensi* in Quetta in 1997

Locality*	Months	Mean No. of *A. culicifacies* from two sites	Mean No. of *A. stephensi* from two sites
Rural	January	1	0
Urban		0	0
Rural	February	0	0
Urban		0	0
Rural	March	0	0
Urban		0	0
Rural	April	6	0
Urban		2	0
Rural	May	20	5
Urban		2	1
Rural	June	35	16
Urban		4	2
Rural	July	28	14
Urban		3	3
Rural	August	28	20
Urban		2	3
Rural	September	18	28
Urban		2	6
Rural	October	10	15
Urban		1	3
Rural	November	0	6
Urban		0	1
Rural	December	0	0
Urban		0	0

*Each locality of rural and urban represents two sites of collection

plays a positive role in rising the numerical prevalence of the vector. Figure 3 indicates that rainfall during these months provides better breeding places for the larvae and adult. As a result peak in the numerical prevalence of *Anopheles* species is reached. During early winters rainfall appear to be detrimental to the *Anopheles* life.

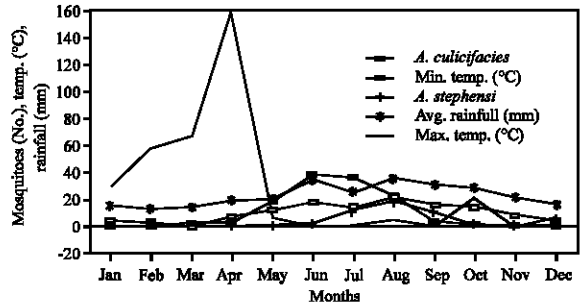

Fig. 1: Seasonal prevalence of vectors in Quetta urban in 1995

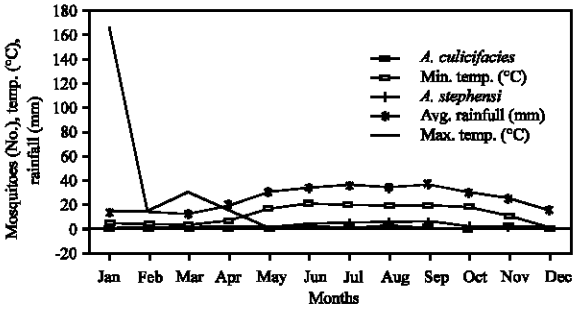

Fig. 2: Seasonal prevalence of vectors in Quetta urban in 1996

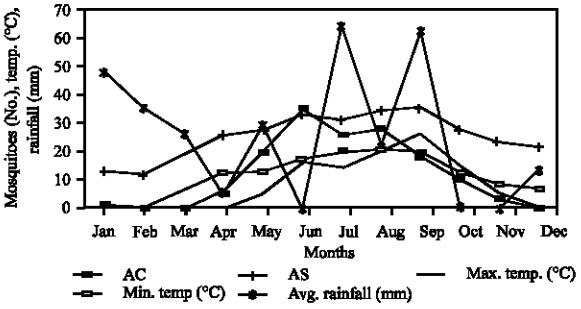

Fig. 3: Seasonal prevalence of vectors in Quetta urban in 1997

December, January and February are the coldest months when the temperature falls below freezing point, which greatly retards the development of larvae (Fig. 1-3).

From the above discussion it is therefore evaluated that the temperature, between 25°C (77°F) and 37°C (98.5°F) appear to be the most suitable climatic conditions for *Anopheles* species.

The most distressing fact observed is the growing number of *A. stephensi* in Quetta city, both in rural and urban areas (Fig. 4). In the urban areas, density of *A. stephensi* dominates largely over *A. culicfaces* in both the sites. Therefore, *A. stephensi* could be regarded as the expected vector of Quetta city. The changing pattern of

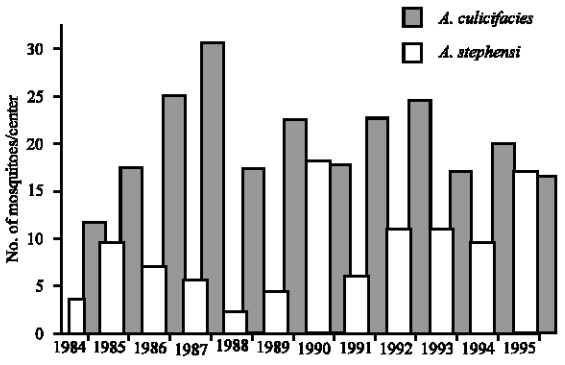

Fig. 4: Total density of the vectors *A. culicifaces* and *A. stephensi* in Quetta rural from 1984-1995

vector in rural area (Fig. 4) must be due to indoor resting habit of *A. stephensi*[4]. This could be attributed to the migration of million of Afghan refugees living mostly in the suburbs of Quetta, which supported *A. stephensi* habit by providing them indoor shelters. Increase in cases of malaria has been reported after the migration of Afghans[6,7]. Lack of immunity caused by malnourishment and other harsh migrating conditions might be the most probable reason for high malaria incidence in Afghans[6]. It is believed that *A. stephensi* might be responsible for the high incidence of malaria in Afghan refugees camps[8]. However the presence of *A. culicifaces* in the above mentioned area could not be ignored. The larger number of *A. culicifacies* may also be attributed to its higher survivorship than *A. stephensi*[9]. Rehman and Muttalib[10] observed a displacement of vector in Karachi and detected *A. stephensi* as the primary vector. It seems that a similar displacement of vector might have occurred by the rapid urbanization of Quetta city.

On the other hand, both these species has been found to be more prevalent in the rural areas of the city. This could be credited to the annual spray conducted by the office of Malaria Control Program in the urban areas. In the urban area of Quetta, the dirty road side trashes and overflowing gutters are inhabited by the nonsense mosquitoes, the Culex, which rule the city.

Moreover, the increase and predominance of *Plasmodium falciparum* in the later transmission[7], season in the region could be endorsed to the presence and increase of *A. stephensi* in this season (Fig. 3). In conclusion, it appear that *A. culicifacies* still remains the most important vector species in Quetta although the growing number of *A. stephensi* could not be ignored.

The entomological data analyzed here pertaining to the years 1984-95 is based on the collection from the suburbs of Quetta, was very kindly provided by Malaria Control Centre. It was analyzed to compare the seasonal abundance of the vector, study the changing pattern of the vector and the effect of population explosion caused by the arrival of Afghan refugees in Quetta.

After the worldwide malaria eradication efforts of the 1960s malaria resurged in 1970s, but declined in the early 1970s (Government of Balochistan). In 1980 the borders were opened for Afghan refugees. Their rapid pouring converted the green agricultural land into populated small houses made mostly of mud, with dirty water running on road sides, immensely increased the density of mosquitoes.

Moreover, it seems that these migrating human beings had been a reservoir of infection. They may be asymptomatic but appears to be the carrier of gametocytes which could be highly infective to the local *Anopheles*. Most of the immigrants belonged to a low income malnourished group which is highly susceptible to all sorts of infections. Malaria epidemic takes place amongst a population under severe mal nutrition, having a disease which causes a decline in resistance for all other infections[11].

The incomplete data from Malaria Control Centre made the analysis some what difficult, especially for the years of 1984, 1985 and 1986. For the years 1984 and 1985 the data of only 2-3 month was available, but luckily these months included the period during which the vector prevails. Routine vector collection was done from 5-6 different sites lying in the suburbs of Quetta. Comparison of the data from 1984 to 1995 (Fig. 4) show a gradual increase in the density of mosquitoes in spite of the regular annual melathion spray. The density of both the vectors appears to be very low in June of 1984. In 1985 there is an early appearance of both the vectors with a considerable rise in their intensity also. In 1987 the density of both the vectors increased tremendously. It seems that either the meteorological conditions were very favorable or the localities were not sprayed properly.

Results of 1988 were quite amazing, since the number of *A. stephensi* dropped down in a drastic manner, but the very next year there was an increase in the density of both the vectors. In 1990 the density of *A. stephensi* increased enormously and far exceeded the density of *A. culicifacies*; but did not succeeded in maintaining the high density in 1991. In 1992 a high density of both the vectors was seen and *A. stephensi* was again capable of increasing its density, which did not last very long and dropped in 1993. However, this decline was not very low as compared with the number of *A. culicifacies*. This indicates that either *A. stephensi* had acquired itself to the environment or has become resistant to the malathion spray.

In seems that *A. stephensi* had been trying its best since its first increase in 1987 to get adapted to the

prevailing conditions. After seven years of ups and downs *A. stephensi* finally succeeded in overwhelming the number of *A. culicifacies*. Comparison of the data for the years 1984 and 1995 indicates the great difference during these eleven years. Not only the total density of both the vectors increased immensely, but the prevailing vector of the rural area changed completely. *A. culicifacies* had been assigned as a vector of rural area[12], where its high density was attributed to its higher survivorship in out door areas[9], clear agricultural water and animal sheds. The indoor resting habit of *A. stephensi*[4] played a great role in the spread of this species, which was further assisted by the growing number of houses. Therefore, *A. stephensi* could be regarded as the expected vector of Quetta.

ACKNOWLEDGMENT

I am thankful to the administration of Malaria Control office for their co-operation and assistance in carrying out this study.

REFERENCES

1. Bruce-Chwatt, L.J., 1980. Essential Malariology. William Heinemann Medical Books Ltd. London.
2. World Health Organization, 1979. Technical Report No. 9. The Clinical Management of Acute Malaria.
3. National Institute of Malaria Research and Training, 1995. Data from Annual Diary, Lahore, Pakistan.
4. Iqbal, F., 1959. Malaria in Quetta and Kalat region. M.Phil. Thesis. University of the Punjab. Pakistan.
5. Mahmood, F. and M. Macdonald, 1986. Ecology of malaria transmission in Sind. Pak. J. Med. Res., 4: 61-67.
6. Mansoor, A., S.M. Mari and S. Nasir, 2003. Blood Biochemical Analysis of Afghan Malaria Patients. J. Med. Sci., 3: 294-297.
7. Mansoor, A., S.M. Marri and H. Naqvi, 2003. Resurgence of malaria in Quetta. J. Med. Sci., 3: 214-219.
8. De Zueleta, 1974. Characteristics of the malaria vetors, *Anopheles culicifacies* and *Anopheles stephensi* in Afghans. J. Med. Entmol., 17: 211-215.
9. Reisen, W.K. and F. Mahmood, 1980. Horizontal life table characteristics of the malaria vetors, *Anopheles culicifacies* and *Anopheles stephensi*. J. Med. Entmol., 17: 211-215.
10. Rehman, Z. and M. Mutlib, 1967. Changing pattern of malaria transmission in Karachi. Pak. J. Med. Res., 2: 41-52.
11. Farid, K.T., 1980. Studies of chloroquine sensitivity of *P. falciparum* resistant to chloroquine and efficacy of alternate drugs. Report. Directorate of Malaria Control, Rawalpindi.
12. Mahmood, F., 1984. Inversion polymorphism in natural populations of *Anopheles stephensi*. Canad. J. Gen. Cyto., 26: 538-546.