International Journal of Modern Biology and Medicine, 2013, 4(1): 30-39

International Journal of Modern Biology and Medicine **ISSN: 2165-0136**

Journal homepage: www.ModernScientificPress.com/Journals/IJBioMed.aspx *Florida, USA*

Article

Epidemiology of Malaria in Urban and Rural Areas of Bannu District Khyber Pakhtunkhwa, Pakistan

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Article history: Received 15 May 2013, Received in revised form 24 June 2013, Accepted 30 June 2013, Published 6 July 2013.

Abstract: A parasitological survey was conducted to know the epidemiology of malaria and their causes in different conditions. The present study was performed from January 2012 to January 2013, during which a total 9864 individuals were examined by a smear microscopy, out of which 1712 (17.35%) cases were found positive. Among the total positive cases, 91.53% were infected with *Plasmodium vivax* and 7.47% were infected with *Plasmodium falciparum*. Mix infection of *Plasmodium vivax* and *Plasmodium falciparum* was found in 0.99% of the total individuals. *Plasmodium vivax* was found to be more prominent 91.53%. In second attempt another survey was conducted in Shamshi Khel village, in which a total of 941 subjects were checked by RDTs method, 305 (32.41%) were found positive for malaria parasite. In this survey *Plasmodium vivax* was more frequent (60.32%) than *Plasmodium falciparum* (28.85%), and mix infections were found in 10.81% of the individuals. Children of age group 5-14 years were more affected, and prevalence of the disease was higher in rural areas (81.19%).

Keywords: epidemiology; mix infection; *Plasmodium vivax; Plasmodium falciparum*; malaria; Pakistan.

1. Introduction

Malaria is one of the global public health problems and imposes a major burden on health in under developed countries of world. Half of world population is at risk of malaria with an estimated 250 million clinical cases and nearly one million deaths were reported (Awan *et al.,* 2012 a). The disease is caused by five plasmodia; *Plasmodium vivax, Plasmodium falciparum, Plasmodium ovale, Plasmodium malariae* and *Plasmodium knowlesi*. Of the total malaria cases, about 80% are due to *P. falciparum*, and is responsible for about 90% deaths (Meddis *et al.,* 2001). Among the five species of Plasmodium *P. vivax* and *P. falciparum* are more prevalent in Pakistan (Murtaza *et al.,* 2004).

The development of drug-resistant parasites malaria, staged a huge comeback in large areas of the world (Najera, 2001). An increase in population in malarious regions, compounded by weak public health systems in developing countries, climate changes (Hay *et al*., 2002), new agriculture practices such as irrigation and dam construction (Sachs and Malaney, 2002) increased resistance to antimalarial treatments and insecticides (Bozdech *et al.,* 2003) and the complexity and flexibility of the genetics (Gardner *et al*., 2002) have all contributed to the increase in malaria. It precipitates such terribly mutilating afflictions in children such as anemia, renal failure, pulmonary edema, and coma, which may be fatal (Eze and Mazeli, 2001).

The presentation may include fever, shivering, headache, vomiting, arthralgia, jaundice hemolytic anemia, hemoglobinuria, retinal damage (Beare *et al.*, 2006), splenomegaly, thrombocytopenia, and hyperbilirubinemia (Nadjm and Behrens, 2012). Malaria has a bad impact on both social and economic development (Sachs and Malaney, 2002). The role of blood group is significant against malaria, individuals with non-O blood group were reported to affect by severe malaria (Fischer and Boone, 1998). Epidemiological factors include climatic conditions (relative humidity, rainfall level, altitudes, temperature) and socio-economic factors. All these factors favor the availability of vectors which maintain the transmission of malaria (Burtler, 1996).

There are three known ways by which the malaria can be transmitted; vector transmission (Anderson *et al.,* 1981), blood transfusion (Strickland, 1999) and congenital transmission (Ezechukwu *et al.,* 2004). The female anopheles mosquito is the main vector for malaria parasite (Cheesbrough, 1998).

Malaria is a serious problem in Sudan, and estimated 7-7.8 million cases of the disease occur annually with a 20% mortality rate (Snow *et al.,* 2005). In northern Nigeria *P. falciparum* malaria cases were significantly more in female patients as compared to male(Bello *et al*., 2005). In tropical Africa, malaria affecting both young and old with 80% mortality rate (Afolabi, 2001), and this is due to the limited access to treatment (Weather *et al*., 2002). According to an estimation, that in Africa 200 children die of malaria every hour of each day all year round *(*Jepsen, *2000*), while each

year at least 24 million pregnant women are threatened by malaria infection (Shane, 2004).

Epidemiological data from different regions of Pakistan is insufficient to exactly assess the incidence of malaria (Khan *et al*., 2006). Every year in Pakistan an estimated ¼ million episodes of malaria infection occur (Yasinzai and Kakar Suleman Khel, 2009). Afghan refugees, in Pakistan are at high risk of malaria infection rather than that brought a high infection load with them from Afghanistan (Suleman, 1988). Each year, there are 350-500 million cases of malaria, killing young children in sub-Saharan Africa (Snow *et al.,* 2005).

2. Materials and Methods

The study was conducted in the Malarial Research Laboratory, in Women and Children Hospital Bannu by microscopy method and in Shamshi Khel Village Bannu by RDTs method, where transmission of malaria is perennial. For epidemiological study total 9864 individuals were studied and 941 suspected patients were performed by RDTs method dating from January 2012 to January 2013. All these individuals had one or more health problems such as, fever, shivering, vomiting, headache, joint pain nausea etc. Questionnaires were used to obtain information on demographic variables such as age, gender, residential area and antimalarial drugs previously used, and last episode of malaria were also collected from all the participants. Study participants were grouped into three age groups: less than 5 years, 5-14 years, and more than14 years.

2.1. Laboratory Diagnosis

In this study two diagnostic tests were performed; Giemsa's stain microscopy and Rapid Diagnostic Tests (RDTs).

2.2. Microscopy Method

Malaria parasitaemia was determined by blood smear microscopy. Thick and thin peripheral blood films were made on the same slide from each sample. The thin film was carefully fixed with methanol and all the slides were flooded with Giemsa's stain. The thick smear was used to screen for the presence of organisms, and the thin smear was used for species identification. It is important to identify the species, because the treatment of different species can differ. The slides were stained for 20 min and examined microscopically for the presence of Plasmodium species.

2.3. Rapid Diagnostic Tests (RDTs)

In this test first of all cleaned the area to be lanced with an alcohol swab, and then squeezed the end of the fingertip and pierce with a sterile lancet provided, and wiped away the first drop of blood

with sterile gauze or cotton. Taken a sample pipette provided, while gently squeezing the bulb, immersed the open end in the blood drop and then gently released the pressure to draw blood into the sample pipette up to the 5 μl guide line.

The device (strip) was placed on a level surface after opening from the foil pouch, and then transferred 5 μl of whole blood into the sample well, and added two drops (60 μl) of assay diluents into the diluents well. Read the test result within 20 min.

3. Results

The epidemiological study of malaria was performed in district Bannu from January 2012 to January 2013. The first attempt of this research was conducted in Women and Children Hospital District Bannu, and pointed out the gender wise, age wise, and locality wise data. During this research, different kinds of malaria (*P. vivax, P. falciparum* and mix infections) were studied in various parts of Bannu District. Affected patients were picked up and probe into the major cause of this disease particularly in Shamshi Khel village of this district.

3.1. Microscopy Results

During this research, a total of 9864 individuals were checked for malaria. Out of these, 1712 (17.35%) were found positive for malaria parasite including 1567 (91.53%) *P. vivax* and 128 (7.47%) *P. falciparum* and 17 (0.99%) were having mixed infection of both the species (Table 1).

Table 1. Distribution of malaria parasite (Microscopy) in Bannu District (n = 1712)

S. No.	Plasmodium species	Found positive	Percentage
1	*P. vivax*	1567	91.53
2	*P. falciparum*	128	7.47
3	Mixed infections	17	0.99
	Total	1712	100

3.2. Sex Wise Prevalence of Malaria in Bannu District

Of the total positive cases 858 (50.11%) were males and 854 (49.88%) were females. Among 858 male patients, 57 (6.64%) were found to be infected with *P. falciparum*, and 792 (92.30%) were infected with *P. vivax*. Only 09 (1.04%) individuals were found to have mix malaria infection (Table 2). In 854 female patients, 71 (8.31%) were infected with *P. falciparum*, and 775 (90.74%) were

infected with *P. vivax*. Similarly, 8 (0.93%) of the female patients were found to have mix malaria infection (Table 3).

Table 2. Prevalence of malaria in male patients of various age groups (Microscopy)

Age group	**Species of malaria parasite**		
	P. vivax	*P. falciparum*	Mixed infection
<5	283	22	3
5-14	389	25	5
>14	120	10	1
Total	792 (92.30%)	57 (6.64%)	9 (1.04%)

Table 3. Prevalence of malaria in female patients of various age groups (Microscopy)

Age group	**Species of malaria parasite**		
	P. vivax	*P. falciparum*	Mixed infection
<5	266	14	3
5-14	317	27	3
>14	192	30	2
Total	775 (90.74 %)	71 (8.31%)	8 (0.93%)

3.3. Prevalence of Malaria in Urban and Rural Areas of Bannu District

While considering the demographic distribution of malaria, the prevalence was higher in rural areas 1390 (81.19%) as compared to urban areas 322 (18.80%) (Fig. 1).

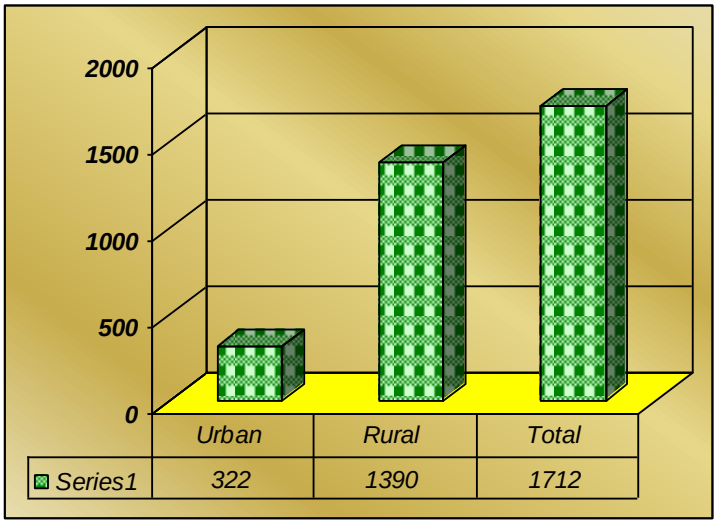

Figure 1. Demographic distribution of malaria in Bannu District

3.4. RDTs Results (in Shamshi Khel)

While following RDTs method, a total of 941 suspected individuals were checked for malaria, among which 184 (60.32%) were found positive for *Plasmodium vivax* and 88 (28.85%) for *Plasmodium falciparum* while mix infection was found in 33 (10.81%) patients (Fig. 2).

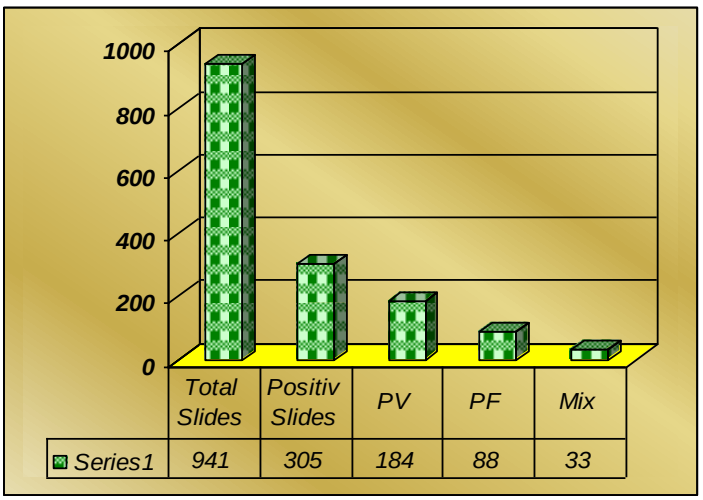

Figure 2. Prevalence of malaria in Shamshi Khel village of District Bannu

4. Discussion

The study was conducted from January 2012 to January 2013 in malaria research laboratory of Women and Children Hospital and in Shamshi Khel village of Bannu district. There was a high prevalence of malaria in this village due to the presence of marshy and stagnant water. So, high population of mosquitoes is likely to occur in such poor sanitary conditions. The high incidence of this disease is also due to the rice fields and dates dropping to the stagnant water producing favorable environmental conditions for mosquitoes breeding. Epidemiologically the rate of the infection of *P. vivax* was higher than *P. falciparum* and mix malaria in the present study. In current work, the male infection rate (50.11%) was found to be high than the female infection rate (49.88%) of age group from 5-14 years. Awan and Jan (2008), investigated that the infection rate in male (7.18%) was found to be high than the female infection rate (6.66%). According to Awan *et al.* (2012a), the male and female children of both sexes of the age group (5-15) were equally exposed to malaria risk in district Bannu. The possible reason is that children of both genders in this age group (5-14 years) are equally exposed to malaria risk. This high prevalence may be due to more blood films collection from the males than females.

The rate of positive slide in this study was (17.35%) in case of microscopy and RDTs positive cases were 32.41%. In this study, the prevalence of *P. vivax* was observed to be higher (91.53%) as compared with that of *P. falciparum* (7.47%). Similarly, Yar *et al.* (1998) while studying incidence of malarial parasite species in Multan district, observed high prevalence of *P. vivax* (60.50%) and a low incidence of *P. falciparum* (37.20%). Similarly, Jan and Kiani (2001) while studying malarial parasites in Kashmiri refugees settled in Muzaffarabad reported high incidence (6.33%) of *P. vivax* than of *P. falciparum* (0.67%). Mohammad and Hussain (2003) observed high incidence of *P. vivax* (5.78%) and 1.08% *P. falciparum.* Malaria in Karachi and other areas in Sindh was studied by Mahmood (2005) who observed *P. vivax* to be two times higher than *P. falciparum*. Idris *et al.* (2007) while studying pattern of malarial infection at Ayub Teaching Hospital, Abbottabad found that out of 1994 patients screened, 145 (7.2%) were found infected. *P. vivax* was seen in the majority (72.4%) than *P. falciparum* (24.1%).

The rate of infection of *P. vivax* was higher than *P. falciparum* in the present study, because there seems to be no second exothermic cycle and true relapses do not occur in *P. falciparum*, where as in *P. vivax* relapses are present (Robert *et al*., 1996). The second reason is that the longevity of *P. falciparum* in man seldom exceeds one year and *P. vivax* usually die-out within three years (Bruce-Chwatt., 1980). In Pakistan, Akbar (2002) reported malaria at a children hospital Baqai Medical University and observed high incidence of *falciparum* as compared to *vivax* (65% vs 35%).

The current work investigated that the prevalence of *P. falciparum* (28.85%) was high in rural areas than urban (7.47%). Nizamani *et al.* (2006) found that *P. falciparum* ratio was noted to be increasing in many districts of Sindh. Malaria in Khyber Pakhtunkhwa was studied by Iqbal *et al.* (2006) and observed cerebral malaria more common in males and most vulnerable group was pregnant ladies.

5. Conclusions

A parasitological survey has been conducted to know the epidemiology of malaria and their causes in different conditions. A total 9864 individuals were examined by a smear microscopy, out of which 1712 (17.35%) cases were found positive. Among the total positive cases, 91.53% were infected with *Plasmodium vivax* and 7.47% were infected with *Plasmodium falciparum*. Mix infection of *Plasmodium vivax* and *Plasmodium falciparum* was found in 0.99% of the total individuals. In addition, a total of 941 subjects were checked by RDTs method, 305 (32.41%) were found positive for malaria parasite. *Plasmodium vivax* was more frequent (60.32%) than *Plasmodium falciparum* (28.85%) and mix infections were found in 10.81% of the individuals. Children of age group 5-14 years were more affected and prevalence of the disease was higher in rural areas (81.19%).

References

Afolabi, B. M. (2001). Malaria: The global scourge. *Nsig. Clin.,* **5**: 9-12.

Akbar, J. U. (2002). Malaria in children at a children hospital. *J. Surg. Pak.,* **7**(3): 20-22.

Anderson, G. C., Morton, H., and Green, I. (1981). *Community Health*, 3rd Ed. Churchill Livingstone, USA, PP. 45-68.

Awan, Z. U. R., and Jan, A. H. (2008). Rice fields in relation to malaria in district Bannu, Khyber Pakhtunkhwa. *Proc. Pakistan Congr. Zool.,* **28**: 11-21.

Awan, Z. U. R., Khan, A. K., Shah, A. H., Suleman, M., and Khan, M. A. (2012a). Assessment of Malaria Prevalence among school children in rural areas of Bannu District Khyber Pakhtunkhwa, Pakistan. *Pakistan J. Zool.,* **44**: 321-326.

Awan, Z. U. R., Shah, H.T.A., Shah, A. H., Suleman, M., and Khan, M. A. (2012b). Malaria among the students of religious schools of Bannu District. *Pakistan J. Zool.,* **44:** 959-962.

Beare, N. A., Taylor, T. E., Harding, S. P., Lewallen, S., and Molyneux, M. E. (2006). Malarial retinopathy: A newly established diagnostic sign in severe malaria. *Am. J. Trop. Med. Hyg.,* **75**: 790-797.

Bello, S. O., Muhammad, B. Y., Bello, A. Y., Ukatu, A. I., Ahmad, B. M., Adeneye, A. A., and Cherima, J. Y. (2005). The pattern of infection and in vivo response to chloroquine by uncomplicated *Plasmodium falciparum* malaria in northwestern Nigeria. *Afr. J. Biotechnol.,* **4**: 79-82.

Bozdech, Z., Llinas, M., Pulliam, B. L., Wong, E. D., Zhu, J., and Derisi, J. L. (2003). The transcriptome of the intraerythrocytic developmental cycle of *Plasmodium falciparum*. *Plos Biology,* **1**: 85-100.

Bruce-Chwatt, L. J. (1980). *Essential Malariology*, 1st Ed. Heinemann, London.

Burtler, D. (1996). Time to put malaria control on the global agenda. *Nature,* **386**: 535-536.

Cheesbrough, M. (1998). *District Laboratory Practice in Tropical Countries*. Cambridge University Press, Cambridge.

Eze, K. C., and Mazeli, F. O. (2001). Radiological manifestation of malaria. *Resid Doc.,* **5**(10): 41.

Ezechukwu, C. I., Ekejindu, E., Ugochukwu, B., and Oguatu, M. (2004). Congenitally acquired malaria in hyper-endemic areas: A cohort study. *Trop. J. Med.,* **8**: 44-49.

Fischer, G., and Boone, P. (1998). Severe malaria associated with blood group. *Am. J. Trop. Med. Hyg.,* **58**: 122-123.

Gardner, M. J. (2002). Genome sequence of the human malaria parasite *Plasmodium falciparum*. *Nature,* **419**: 498-511.

Hay, S. I., Cox, J., Rogers, D. J., Randolph, S. E., Stern, D. I., Shanks, D. G., Myers, M. F., and Snow,

R.W. (2002). Climate change and the resurgence of malaria in the East African highlands. *Nature,* **415**: 905-909.

Idris, M., Sarwar, J., and Fareed, J. (2007). Pattern of malaria infection diagnosed at Ayub Teaching Hospital Abbottabad. *J. Ayub Med. Coll. Abbottabad,* **19**: 35-36.

Iqbal, S., Pirzada, A. H., Rahman, S., and Iman, N. (2006). Cerebral malaria, an experience in NWFP, Pakistan. *J. Med. Sci.,* **14**: 35-39.

Jan, A. H., and Kiani, T. A. (2001). Haematozoan parasites in Kashmiri refugees. *Pakistan J. Med. Res.,* **40**: 10-12.

Jepsen, S. (2000). Malaria vaccines: Which vaccines to whom? *Tidsskrift for Den Norske Largeforening,* **120**: 1665-1668.

Khan, H. U., Khattak, A. M., Khan, M. H., Mahsud, I. U., and Shah, S. H. (2006). A study of prevalence of malaria in adult population of D. I. Khan, Pakistan. *Biomedica,* **2**: 99-104.

Mahmood, K. H. (2005). Malaria in Karachi and other areas in Sindh. *Pak. Armed Forces Med. J.*, **55**: 345-348.

Meddis, K. B., Sinal, P., Marchesini, G., and Carter, R. (2001). The neglected burden of *Plasmodium vivax* malaria. *Am. J. Trop. Med. Hyg.,* **64**: 97-106.

Mohammad, N., and Hussain, A. (2003). Prevalence of malaria in general population of district Buner. *J. Pakistan Med. Inst.,* **17**: 75-80.

Murtaza, G., Memon, I. A., and Noorani, A. K. (2004). Malaria prevalence in Sindh. *Med. Channel,* **10**: 41-42.

Nadjm, B., and Behrens, R. H. (2012). Malaria: An update for physicians. *Infect. Dis. Clin. North Amer.,* **26**: 243-259.

Najera, J. A. (2001). Malaria control: Achievements, problems and strategies. *Parasitologia,* **43**: 1-89.

Nizamani, A., Kalar, N. A., and Khushk, I. A. (2006). Burden of malaria in Sindh, Pakistan. *J. Liaqat Uni. Med. Health Sci.,* **5**: 76-83.

Robert, L. S., Janovy, F., and Schmidt, G. D. (1996). *Foundation of Parasitology*, 5th Ed. W.C. Brown.

Sachs, J., and Malaney, P. (2002). The economic and social burden of malaria. *Nature,* **415**: 680-685.

Shane, B. (2004). Malaria continues to threaten pregnant women and children. Population Reference Bureau from www.who.int/inf-fs/en/fact094.html.

Snow, R. W., Guerra, C. A., Noor, A. M., Myint, H. Y., and Hay, S. I. (2005). The global distribution of clinical episodes of *Plasmodium falciparum* malaria. *Nature,* **434**: 214-217.

Strickl, G. T. (1999). Life cycle of malaria parasite. *Trop. Med.,* **25**: 586-601.

Suleman, M. (1988). Prevalence of malaria in Afghan refugees in Pakistan. *Trans. R. Soc. Trop. Med. Hyg.,* **82**: 44-47.

Weather, D. J., Miller, L. H., Baruch, D. I., Marchm, K., Doumbo, O. K., Casals-Pascual, C., and

Roberts, D. J. (2002). Malaria and red cell. Haematol. Am. Soc. Haematol. Educ. Program., pp. 35-57.

Yar, H. M. K., Masood, A., Maqbool, U., and Malik, G. Q. (1998). Prevalence of malarial parasite species in Multan district. *The Professional*, **5**: 183-187.

Yasinzai, M. I., and Kakar Suleman Khel, J. K. (2009). Prevalence of human malaria infection in bordering areas of East Balochistan, adjoining with Punjab: Loralai and Musakhel. *J. Pak. Med. Assoc.*, **59**: 132-135.