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Assessment of Malaria Prevalence Among School Children In Rural Areas of Bannu District Khyber Pakhtunkhwa, Pakistan

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Abstract.- To assess the prevalence of malaria among the primary school students in rural areas of Bannu district, a parasitological survey was conducted during April – May 2003. A total of 556 schools children (ages 5-15 years) from 11 school were examined by a smear survey, 17 (3.06%) were found positive for malaria parasite. *Plasmodium vivax* was more frequent (2.69%) than *Plasmodium falciparum* (0.35%). Malaria was equally prevalent among male (3.06%) and female (3.03%) children. The prevalence of malaria was slightly higher in children from houses having no wire-screen in windows (3.6%) than the once from houses fitted with wire-screen in windows (1.42%). The prevalence of malaria was higher in children who slept outdoor (4.78%) than in those who slept indoor (1.84%). There was no statistically significant difference between the prevalent rates of malaria in children having domestic animals in their houses (3.61%) and in those having no domestic animals in their houses (2.04%). The intensity of malaria parasite assessed as the number of parasite per 10 WBCs varied from 2 to 13.

Key words: Domestic animals, malaria prevalence, *Plasmodium falciparum.*

INTRODUCTION

Malaria is a leading cause of morbidity and mortality in the developing world, especially in Sub Saharan Africa where the transmission rate is highest and there it is considered as a major obstruction to economic development (Sachs and Malanet, 2002).

In Pakistan malaria is quite common. From different regions of Pakistan epidemiological data is insufficient to exactly assess the prevalence of malaria (Khan *et al.,* 2006). *Plasmodium falciparum* is an important public health problem, which annually causing at least ½ million cases of malaria (Ghanchi *et al.,* 2010). In Pakistan, each year an estimated ¼ million episodes of malaria infection occur (Yasinzai and Kakarsulemankhel, 2009). The malaria incidence has strikingly increased during the last ten years and the relative rate of recurrence of *P. falciparum* has increased from 45% in 1995 to 68% in 2006 amongst malaria infections (Ghanchi *et al.,* 2011). Afghan refugees, being more susceptible, are at high risk of malaria infection in Pakistan rather than that they brought a high infection load with them from Afghanistan (Suleman, 1988).

Malaria is such a disease which can be stopped and it is a curable disease. Its causal agent is a *Plasmodium* spp. parasite. It is transmitted through out the world by a specific number of *Anopheles* vector mosquitoes. It is basically an environmental disease since the required specific habitats with surface water for reproduction and moisture for adult mosquitoes survival and the development rate of both the vector and parasite population is influenced by temperature (Ceccato *et al.,* 2005). The trait, glucose-6-phosphate dehydrogenase (G-6-PD) deficiency in Afghan refugees and a local community in the North-West Frontier Province, Pakistan, is most common among Pathan and Uzbak refugees. The type of G-6-PD deficiency in Pathans could cause severe haemolytic crises (Bouma *et al.,* 1995).

There are various reasons of the continuation and re-emergence of malaria, for example, economic reasons, declining control programs and mosquitoes/parasite adaptation to pesticides drugs and environmental changes all contribute or play a pivotal role in the development and increase of the malaria disease. In some countries, especially, in

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Africa the movements of population for political or economic reasons create another dangerous factor to the spreading of malaria. Similarly, migrants and the various refugees may bring new parasites to the area and increase transmission in settled population, or because they come from a low, no transmission area migrants and refugees may be highly vulnerable to severe disease when they enter a malaria endemic area (Giada *et al.*, 2003).

MATERIALS AND METHODS

The study was conducted in the primary schools of rural areas of Bannu district, NWFP, during the months of April – May 2003. A complete list of the primary schools was obtained from the Executive District Office (EDO), Elementary and Secondary Education Bannu. The total number of primary schools in rural areas was 293 on record (in urban areas the number of primary schools was 110). Eleven schools were randomly selected from the list. For malaria control programme and surveillance, the Bannu district was divided into 3 main sectors, A, B and C. These sectors were further sub divided into sub sectors. The sub sectors contained index localities and similarly each of the localities has been divided into several villages (Table I).

A total of 556 blood films were collected of the school children from the age between 5 -15 years belonging to eleven primary schools of rural areas of Bannu district. The schools surveyed were located in the different localities of sectors A, B and C. The blood films collected from eleven schools belonging to different sectors are as follows (Table I):

Both thick and thin blood smears were obtained on the same slide. The fingertip of the volunteer was cleaned with methylated spirit and then pricked with a sterilized lancet. A drop of blood was placed on one side of the slide and a thick smear was made with the help of the corner of another slide. Another drop was taken in the middle of the slide and the edge of the second slide was rubbed against it towards the opposite end. The slides were then left to dry, followed by fixation of thin smear with methyl alcohol and labeling. Giemsa's Stain was used for staining. The slides were kept in the working solution (prepared by diluting 5 ml of stock solution in 100 ml of water) of the Giemsa's Stain for 20-30 minutes. These were then cleaned with tap water, dried and screened under XI00 oil immersion power of microscope for the detection of any *Plasmodium.*

A proforma of data report was also filled in during the fieldwork in which information about the volunteer was recorded. This information included: slide No., date, name of volunteer, sex, age, locality, the presence or absence of domestic animals, sleeping habit, etc.

RESULTS

A total of 556 blood smears were studied of which 17 (3.05%) were found positive for malarial parasite. Screening of all these blood films showed that *P. vivax* (2.69%) was more common than *P. falciparum* (0.35%) and mixed infection of both species was not found. A comparison by χ^2 –test indicated the difference to be significant ($\chi^2 = 9.78$; df = 1; $P < 0.05$).

Prevalence of malaria in sector A, B and C

Out of 556 blood smears, 160 were collected from sector A, 185 from sector B and 211 from sector C. The prevalence of malaria was high in sector C (4.26%), and lower in sector A (1.87%). In sector B the infection of malaria parasite was moderate (2.7%) (Table I). However, a comparison by χ^2 –test indicated the difference to be non-significant ($\chi^2 = 1.44$; df = 2; $P > 0.05$).

Age and sex wise prevalence of malaria

The prevalence of malaria was apparently higher among age-group 11 – 15 years (3.12%) as compared to that in age-group 6 – 10 years (3.01%). However, a comparison by χ^2–test indicated the difference to be non-significant ($\chi^2 = 0.006$; df = 1; $P > 0.05$). Out of 556 blood slides, 523 were collected from male children having total 16 (3.06%) *Plasmodium* positive where as the remaining 33 blood samples were collected from female children having total 1 (3.03%) *Plasmodium* positive, showing that malaria was equally prevalent among the male and female children (Table II). A comparison by χ^2–test indicated the difference to be non-significant ($\chi^2 = 0.008$; df = 1; $P > 0.05$).

Table I.- Prevalence of malaria among school children in the 3 sectors of Bannu district during April – May, 2003.

Sector	Name of School	Enrollment	No. examined	*P.v.*[1]	*P.f.*[1]	No. positive	Prevalence (%)
A	G.P.S. Dawood Shah	79	65	1	-	1	1.53
	G.P.S. Mamash Khel	52	45		-	0	0.00
	G.P.S. Sikander Khel	65	50	2	-	2	4.00
Total	**3**	**196**	**160**	**3**	**-**	**3**	**1.87**
B	G.P.S. Bizenkhel	30	27	1	-	1	3.7
	G.P.S. Sadra Van	62	57	1		1	1.75
	G.P.S. Kotka Feroz	81	68	1	1	2	2.94
	G.P.S. Jando Khel	35	33	1	-	1	3.03
Total	**4**	**208**	**185**	**4**	**1**	**5**	**2.7**
C	G.P.S. Bada Mir Abbas	75	60	2	1	3	5.00
	G.P.S. Mandew	57	50	2	-	2	4.00
	G.P.S. Pirkhel Kakki	76	61	1	-	1	1.63
	G.P.S. Ghoriwala	55	40	3	-	3	7.5
Total	**4**	**263**	**211**	**8**	**1**	**9**	**4.26**
Grand Total	**11**	**667**	**556**	**15**	**2**	**17**	**3.06**

[1]*P.v., Plasmodium viviax*; *P.f., Plasmodium falciparum.*

Table II.- Age and sexwise prevalence of malaria in school children of Bannu district during April – May, 2003.

Age group (Years)	Male			Female			Grand total		
	No. examined	Positive	Prevalence %	No. examined	Positive	Prevalence %	No. examined	Positive	Prevalence %
6 - 10	315	9	2.86	17	1	5.88	332	10	3.01
11 - 15	208	7	3.36	16	-	-	224	7	3.12
Total	**523**	**16**	**3.06**	**33**	**1**	**3.03**	**556**	**17**	**3.06**

Table III.- Prevalence of malaria in school children with respect to the presence or absence of wire-screen in windows.

Wire screen (in windows)	No. of slides examined	No. positive	Prevalence (%)
Present	140	2	1.42
Absent	416	15	3.60
Total	**556**	**17**	**3.06**

Prevalence of malaria with respect to the presence or absence of wire-screen and domestic animals

The prevalence rate of malaria was low (1.42%) in children from houses having wire-screen in windows and high rate (3.6%) among those from houses having no wire screen in windows (Table III). However, a comparison by χ^2–test indicated the difference to be non-significant ($\chi^2 = 1.59$; df = 1; P > 0.05). Similarly, the prevalence rate of malaria was high (3.61%) in those children having domestic animals and low prevalence rate (2.04%) was observed in those children having no domestic animals in their houses (Table IV). However, a comparison by χ^2–test indicated the difference to be non-significant ($\chi^2 = 0.99$; df = 1; P > 0.05).

Intensity of malaria parasite/10 WBCs

The intensity of malaria parasite/10 WBCs in school children found positive in all the three sectors (Sector A, B and C). A great deal of variation was found in the intensity of parasite in repeated observation. Hence it is very difficult to accurately ascertain the actual intensity of parasite in any single observation. The intensity of parasite should, therefore, be based on the value from

repeated observation as is done in this study (Table V).

Table IV.- Prevalence of malaria in school children with respect to the presence or absence of domestic animals.

Domestic animals	No. of slides examined	No. positive	Prevalence (%)
Present	196	4	2.04
Absent	360	13	3.61
Total	**556**	**17**	**3.06**

Table V.- Intensity of malaria parasite /10 WBC in school children detected positive.

Parasite	Intensity/10 WBC			
	1st Observation	2nd Observation	3rd Observation	Average
P. vivax	13	20	5	13
P. vivax	11	8	17	12
P. vivax	8	15	3	9
P. vivax	5	10	12	9
P. falciparum	2	1	7	4
P. vivax	3	2	1	2
P. vivax	2	4	2	3
P. vivax	2	1	3	2
P. vivax	5	8	11	8
P. vivax	12	3	15	10
P. vivax	9	5	11	9
P. vivax	7	4	3	5
P. falciparum	6	2	1	3
P. vivax	3	5	3	4
P. vivax	5	8	13	9
P. vivax	7	10	5	8

DISCUSSION

In Pakistan malaria infection is moderately endemic. In prevalence there is variation from area to area and province to province. The Punjab province reports less than 10 percent cases with about 52 percent of population. In the same report (Malaria Case Management Desk Guide, 2007) the malaria reported cases from Sindh province were about 30 percent with 25 percent national population. But the Baluchistan province which constitutes 05 percent of the population of the country contributes over 30 percent of the reported cases. The only prevalent species of malaria parasite are *P. falciparum* and *P. vivax* which was reported in the country but *P. vivax* was the leading species accounting for more than 70% of the malaria trouble in the country. The highest trouble of vivax malaria was reported from Khyber Pakhtunkhwa and the FATA (Federally Administered Tribal Areas), illustrating the need for greater programmatic and health system strengthening in these regions (Murtaza *et al.,* 2009).

This survey was conducted during the months of April and May 2003 in primary schoolchildren of Bannu District. The schools were selected using a statistically sound randomization procedure. The reason for low overall prevalence rate (3.06%) might be because the survey was carried out in drought period when mosquito population was low. The high population of mosquitoes is likely to occur during August to November (rainy season). The prevalence rate of malaria was highest (4.26%) in the school children of sector “C”. It might be due to the poor sanitary conditions, the presence of marshy and stagnant water in this sector. Sector “C” comprised areas near the streams which has attracted a very large number of people due to fertile soils and the presence of water. This high settlement of people resulted in the over crowding of this sector, which is perhaps another cause of high prevalence rate of malaria. The high incidence of sector “C” is due to the rice fields and favorable environmental conditions for mosquito breeding. The prevalence of malaria observed by Awan and Jan (2008) in district Bannu was found to be highest (8%) in sector "C" (the rice growing) area and lowest (5%) in sector "A" (the non-rice growing area). This shows that the rate of infection in sector “C” is higher in both studies as compared to the other sectors.

The prevalence rate of malaria was lowest (1.87%) in school children of sector “A”. The possible reason is that, all the areas of sector “A”, were dry and sandy; with no irrigation system and totally dependent on rainy water. This sector is less populous and the houses were situated at a distance from each other, which might be cause of low prevalence rate of malaria. The rate of infection of *P. vivax* was higher than *P. falciparum* in the current work, 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). The 3rd reason is that *P. falciparum* is more virulent than *P. vivax*; the mortality may reach nearly 50%in children. However, this statement may be considered valid to the countries of tropical Africa, but cannot be considered a strong reason for the high prevalence rate in country like Pakistan.

In the current work malaria came out to be equally prevalent in male (3.06%) and female children (3.03%). The possible reason is that, children of both sexes in this age group (5 – 15 years) are equally exposed to malaria risk. According to Awan and Jan (2008), the male infection rate (7.18%) was found to be high than the females infection rate (6.66%). This high prevalence may be due to more blood films collection from the males than females. The prevalence of malaria was high (4.7%) in those school children who slept outdoor and low (1.84%) in the children who slept inside the room. As malaria vectors in Pakistan are nocturnal, and children who slept outdoor were more exposed to mosquitoes, than those who slept indoor. Similarly, in the current study malaria was not significantly different among the school children having domestic animals in their housed compared with those having no domestic animals ($\chi^2 = 0.99$; df = 1; $P > 0.05$). The parasite prevalence survey conducted by Idrees and Jan (2001) in District Dir examined the possibility that the cattle kept in house courtyard might protect occupants against malaria through Zooprophylaxis.

The prevalence rate of malaria observed during the present work was lower than reported in general population of Bannu district (4.28%) (Jan *et al.*, 2000). The prevalence rate of malaria (7%) in general population of Bannu district (Awan and Jan, 2008) was also higher than the one detected in this study. The prevalence of malaria in Afghan refugees' school going children of Mardan district (Jan and Kaleem, 1993) was very higher (7.91%) than that found in the present work (3.06%). All the above mentioned surveys were carried out during post monsoon (after rainy season), which seems to be a possible reason for higher prevalence rates.

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REFERENCES

AWAN, Z.U.R. AND JAN, A.H. 2008. Rice fields in relation to malaria in district Bannu, NWFP. *Proc. Pakistan Congr. Zool.*, **28:** 11-21.

BOUMA, M. J., GORIS, M., AKHTAR, T., KHAN, N. AND KITA, E., 1995. Prevalence and clinical presentation of glucose-6-phosphate dehydrogenase deficiency in Pakistani Pathan and Afghan refugee communities in Pakistan; implications for the use of primaquine in regional malaria control programmes. *Trans. R. Soc. trop. Med. Hyg.*, **89**: 62-64.

BRUCE-CHWATT, L.J., 1980. *Essential malariology*. 1st Ed. Heinemann, London.

CECCATO, P., CONNO, R.S.J., JEANN, E.I. AND THOMSON, M.C., 2005. Application of geographical information systems and remote sensing technologies for assessing and monitoring malaria risk. *Parassitologia,* **47**: 81-96.

GHANCHI, N.K., MARTENSSON, A., URSING, J., JAFRI, S., BERECZKY, S., HUSSAIN, R. AND BEG, M.A., 2010. Genetic diversity among *Plasmodium falciparum* field isolates in Pakistan measured with PCR genotyping of the merozoite surface protein 1 and 2. *Malar. J.*, **9**: (http:/www.malariajournal.com. content/9/1/1)

GHANCHI, N.K., URSING, J., BEG M.A., VEIGA, M.I., JAFRI, S. AND MARTENSSON, R., 2011. Prevalence of resistance associated polymorphisms in Plasmodium falciparum field isolates from southern Pakistan. *Malar. J.*, **10:**18 (http:/www.malariajournal.com.content/ 10/11/18)

GIADA, S., DE GROEVE, T., EHRLICH, D. AND SOILLE, P., 2003. Can satellite images provide useful information on refugee camps? *Int. J. Rem. Sens.*, **24**: 4249-4250.

IDREES, M. AND JAN, A.H., 2001. Failure of Zooprophylaxis: Cattle ownership increase rather than reduce the prevalence of malaria in District Dir (N.W.F.P). *The Science*, **1**: 52-54.

JAN, A.H., KALEEM, S.M. AND KHAN, S.N., 2000. Prevalence of malaria in general population of Bannu district (N.W.F.P). *J. med. Sci.*, **10**: 69-71.

JAN, A.H. AND KALEEM, S.M., 1993. Incidence of malaria in Afghan refugees' school going children of Mardan district (N.W.F.P). *Pak. J. scient. Technol.*, **17**: 3-4.

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.

MALARIA CASE MANAGEMENT DESK GUIDE FOR CLINICIANS AND HEALTH CARE PROVIDERS, 2007. Directorate of Malaria Control, Ministry of Health. Government of Pakistan.

MURTAZA, G., MEMON, I.A., MEMON, A.R., LAL, M.N. AND KALLAR, N.A., 2009. Malaria morbidity in Sindh and the plasmodium species distribution. *Pakistan J. med. Sci.*, **25:**646–649.

ROBERT, L.S., JANOVY AND SCHMIDT, G.D., 1996. *Foundation of parasitology*. 5th Ed. W.C., Brown, Publishers, London.

SACHS, J. ADN MALANET, P., 2002. The economic and social burden of malaria. *Nature*, **415:** 680-685.

SULEMAN, M., 1988. Prevalence of malaria in Afghan refugees in Pakistan. *Trans. R. Soc. trop. Med. Hyg.*, **82**: 1. 44-47.

YASINZAI, M.I. AND KAKARSULEMANKHEL, 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.

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