Review Article

Significant Reduction of Malaria in the Punjab, Pakistan after Introduction of Roll Back Malaria Strategy in 2003

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ABSTRACT

Aims of Study: The purpose of this study was to understand the malarial situation in Punjab, Pakistan.
Place and Duration of Study: In this study, the data was collected from different health facilities, malaria control programme offices, reference laboratories and field stations of 91 districts from 2005 to 2009.
Materials and Methods: The data of past five years (2005-2009) from health facilities, malaria control programme offices, reference laboratories and field stations was collected. An excel databank was created and analysis was done by using SPSS. Out of the total of 123 districts, 91 districts (86.7%) were endemic for malaria in Pakistan. Balochistan and FATA (Federally Administered Tribal Areas) had highest malaria incidence, while Sind and KPK (Khyber Pakhtoon Khah) had moderate. The lowest malaria incidence was confined to Punjab and AJK (Azad Jammu Kashmir). In Punjab the maximum API (Annual Parasitic Incidence) was noted 0.04 in 2005 and 0.05 in 2009. The incidence of cases in south Punjab was more than central and north Punjab, 82% of indigenous cases were of Plasmodium vivax, 18% were of P.falciparum, P.ovale & P.malariae or mix infection was not reported. In Punjab malaria has reduced significantly (p=0.028) and fully qualifies the embarkation of malaria elimination strategy. Prioritizing to target P.falciparum first and subsequently eliminate the *P.vivax* malaria. KAP (Knowledge, Attitudes and Practices) study is required before initiating malaria elimination in Punjab, Pakistan.
Key Words: Malaria**,** Roll back, elimination, Punjab**,** Pakistan.

INTRODUCTION

Since ancient times, humankind has had to struggle against the pathogenic microorganisms, among which *plasmodium* is still the most important causing malaria worldwide[1]. Malaria is a major public health problem, both treatment and control are hampered by the spread of resistance to common antimalarial drugs which is highly prevalent[2]. Plasmodium falciparum (P.falciparum) resistance to 4-aminoquinolines (chloroquine etc) contributes to increase the malarial morbidity and mortality[3]. Cerebral malaria was reported among 4% and severs anaemia due to malarial was found among 17% of Afghan population admitted in hospitals[4]. Anatoly 2008[5] reported that available data for 1963 to 2007 reveal that malarial endemicity in the Punjab province of Pakistan fluctuated between hypo-to-meso levels during "normal" years and was subjected to "regional" malaria epidemics with periodicity of 5-8 years. Although this classic pattern was altered by the activities of the National Eradication Progrmme, this trend was traced during subsequent years. Thus, the highest malaria incidence was reported in 1974 (API 9.44), reducing to very low level in 1984(0.47). Next increase in malaria incidence occurred in 1984 (1.35) and then in 1992 (0.99), thereafter and up to now the incidence was demonstrating steady declining trend, reaching API 0.02 in 2006.

Malaria is quite common in Pakistan but epidemiological data is insufficient to exactly evaluate the incidence[6,7,8]. Malaria is accountable for every fifth person in D.I.Khan[9]. The PCR analysis confirmed 83.3% P.vivax and 24.6% P.falciparum malaria in Bannu, Pakistan[10]. In Punjab ME (Malaria Eradication) programme worked from 1960-1970, since 1971 MC (Malaria Control) programme is working till to date with RBM (Roll Back Malaria) strategy from 2003. RBM strategies are well tuned to the principles of the Global RBM strategy[11]. RBM strategies aiming for early detection and prompt treatment at the health facilities and in the community, reduced reliance on the use of insecticide by restrict selective deployment of the IRS (In Door Spray) in well defined malaria endemic areas, strengthening of disease surveillance and malaria outbreaks response and BCC (Behavior Change Communication). Laboratory confirmed positive cases treatment as per national treatment guidelines. API (Annual Parasite Incidence), SPR (Slide Positive Rate),

ABER (Annual Blood Examination Rate), MBER (Monthly Blood Examination Rate), Percentage P.falciparum cases and vector density per room in sentinel sites of areas under IRS were important indicators for performance and diseases incidence evaluation.

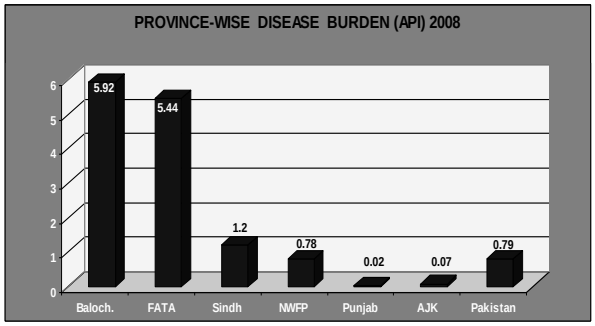
MATREIALS AND METHODS

This study was planned to review the malaria situation in Punjab, Pakistan. Data collection tools of programme were used. Subjects of the study were laboratory confirmed positive humen malaria cases for *P.*falciparum and *P.*vivax. Data was collected from the provincial malaria control programme Punjab, national malaria control programme Pakistan, reference laboratories and field stations for the year 1963 to 2009. Statistical analysis was done by using SPSS program and significance of different variables and correlation was calculated. All positive cases of *P.falciparum* and *P.vivax* were treated with 4-aminoquinoline (chloroquine etc) and 8-aminoquinoline (primaquine) from 1963 to 1996. Later *P.falciparum* cases were treated with sulphadoxine-pyremethamine up 2007. Since 2007 all *P.falciparum* cases are being treated with ACT (Artemisinin Combination Therapy). For vector control IRS was started with DDT (dichlorodiphenyltrichloroethane) in 1963 against which vector became resistant and new group of insecticide OP (organ phosphorus) compound was introduced in 1976. 1992 vector also became resistant against OP compounds; hence, presently use insecticide of pyrethroid (deltamethrin) group was launched and used very carefully by observing scientific techniques. This data was also collected and analyzed.

RESULTS

Province wise malaria situation in Pakistan is presented in the figure 1[12]. It can be seen that, the lowest malaria incidence was confined in two provinces, Punjab and AJK with combined population of more than 56% of total population of the country Figure 1

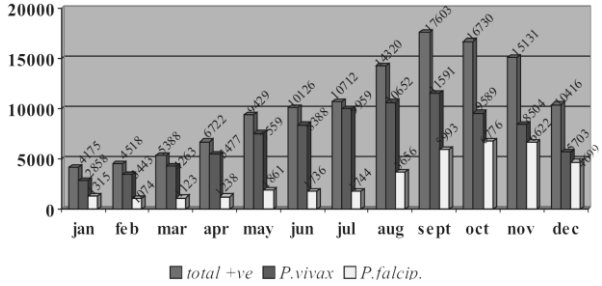
Figure No .1 :Occurrence of malaria in différent areas of Pakistan, 2008.



Malaria incidence less than 1 case per thousand populations per year indicates that malaria is not no more major public health problem in the in the area. However, malaria indicators demonstrate that the system of anti malarial activities carried out during the last few years appears to reach the ceiling of its efficacy, thus necessitating the decision on further course of action.

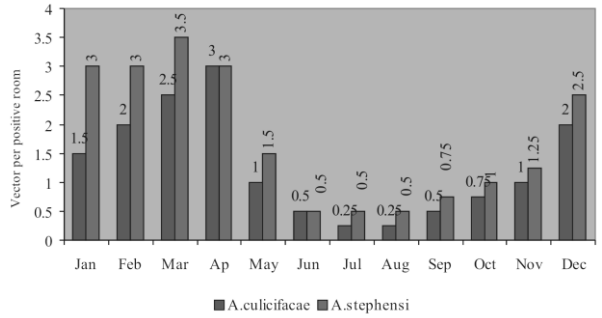
There is a well established seasonal pattern of malaria with the peak of P.vivax transmission during July to October soon after moon soon and that of P.falciparum during October to December as given in figure 2. This pattern showed that during rainy season vector density increases and disease transmission started but in winter season how transmission of P.falciparum occurs. The resistance of P.falciparum is because of recrudescence during this low temperature season.

Figure No.2: Seasonal Pattern of Malaria in Punjab, Pakistan 2005-2009



In Punjab the major malaria vectors were found A.culicifacies and A.stephensi, while mosquitoes of the anopheles genus A.fluviatilis and A.superpictus were also noted. Seasonal trends of major vectors A.culicifacies and A.stephensi in the province are given in figure 3. A.stephensi is represented by both type forms[13]. A.culicifacies and A.stephensi found susceptible to deltamethrin and resistant to Malathion & DDT.

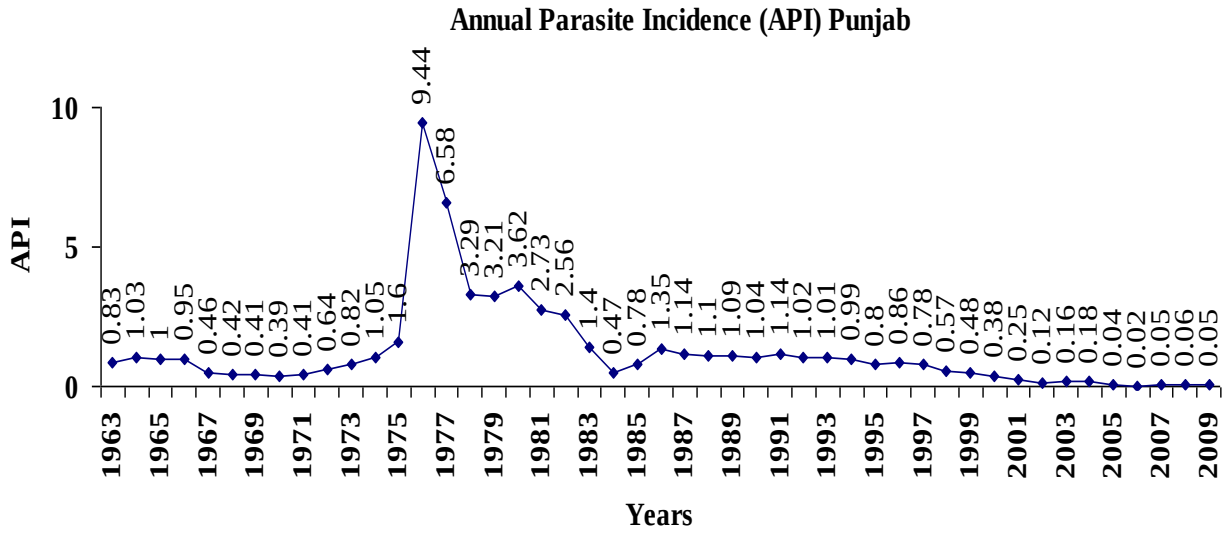
Figure No.3: Seasonal Trend of Malaria Vectors Density in Punjab, Pakistan 2005-2009



In Punjab province data from 1963 to 2009 (Figure 4), reveal that malaria endemicity in the province fluctuated between hypo to meso levels during "normal" years and was subjected to "regional" malaria

epidemics with periodicity of 5-8 years[14]. Although this classic pattern was altered by the activities of the National Eradication Programme, its trend was traced during subsequent years in Malaria Control.

Figure No. 4:Annual Parasite Incidences (API) in Punjab from 1963 to 2009
(Curtsy of Malaria Control Programme Punjab, Pakistan (2009)



Thus, the highest malaria incidence was reported in 1976 (API 9.44%), reducing to low level from 1984(0.47) and thereafter up to now the incidence was demonstrating steady declining trend, reaching API 0.05% in 2009. Overall objective of the programme is to reduce malaria morbidity and eliminate malaria mortality by keeping malaria under effective control so that it does not become a major public health and socio-economic problem.

Table No.1: Results of Drug Monitoring (Chloroquine) in Punjab, Pakistan 2004

	M/garh	D.G.Khan	Rajanpur	Total	%age
Total Subjects	200	200	200	600	100
Lost and Withdrawal	1	10	2	13	2
Analyzed	199	190	198	587	98
LCF	64	59	51	174	29
EPF	22	18	16	56	9
LPF	76	69	71	216	36

LCF; Late Clinical Failure, **EPF;** Early Parasitic Failure, **LPF;** Late Parasitic Failure

Targets to keep malaria under control are incidence less than 2 per 1000 population per year and to have halved by 2015 (which has been already achieved). Thus, it appears that the goal of malaria control programme in Punjab Province (malaria incidence less than 2 per thousand populations) has been achieved since last several years. With malaria incidence less than 1 case per thousand population malaria has ceased to be a major Public health problem in the Province. However, malaria indicators demonstrate that the system of anti malarial activities carried out during the last few years appears to reach the maximum of its efficacy, thus necessitating the decision on further course of action. Local strains of *P.falciparum* resistant to chloroquine were reported[15] as given in table No.1.

In 2004, Out of the total of 105 districts, 91 districts (86.7%) had been affected by malaria as given in table No.2.

Two provinces, namely Balochistan and FATA reported highest malaria incidence, while Sind and KPK provinces reported moderate. *P.vivax* was predominant malaria species. Highest *P.falciparum* malaria proportion was reported in Balochistan and Sind, although it did not exceed 35%. In 2007, out of the total reporting 123 districts, malaria was present in 114 districts (93%). Most remarkable reduction of malaria incidence was shown in Punjab province (almost three times less as compared with 2004); reduction was not observed in other provinces (able No.3).

Data of 2004 and 2007 was analyzed and compared; statistical findings calculated by SPSS-16 are given in table 4. It showed highly significant (p value =0.001) decrease in API of Punjab only by applying paired T-test. In Sind and KPK API decreased but difference was not significant. In all other areas including Pakistan, FATA and Balochistan API was increased significantly. In AJK increase in API was found not significant.

Findings

It appears that the goal of malaria control programme in Punjab Province (malaria incidence less than 2 per thousand populations per year) has been achieved. Malaria incidence reduced in the province after introduction of RBM strategy and has reached its ever

lowest level. This level of incidence fully qualifies for embarkation on implementation of malaria elimination strategy in Punjab Pakistan.

Table No.2:Malaria Situation in Different Provinces of Pakistan, 2004
(Curtsy of Directorate of Malaria Control Pakistan (2008)

Province	Population (000)	Total cases	P.v	P.f	P.f (%)	ABER (%)	SPR (%)	Parasite Incidence	Districts	
									Total	Affected
Punjab	86 157	4 413	3 558	855	19.0	1.72	0.30	0.05	34	33
Sind	36 032	36 447	24142	12207	33.0	3.84	2.63	1.01	16	15
KPK	21 445	23 834	21218	2 221	9.0	1.87	6.04	1.13	24	18
F A T A	3 765	14 665	12327	2 528	17.0	3 66	10.78	3.95	8	8
Balochistan	7 488	31 685	20987	10731	34.0	3.76	11.27	4.23	23	17
A J K	3 424	547	495	58	11.0	4.97	0.32	0.16	NA	NA
Pakistan	158 011	111 781	82727	28600	25.6	2.44	2.90	0.71	105	91

Table No.3: Malaria Situation in Different Areas of Pakistan, 2007
(Curtsy of Directorate of Malaria Control Pakistan (2008)

Province	Population (000)	Total Cases	P.v	P.f	P.f (%)	ABER (%)	SPR (%)	Parasite Incidence	Districts	
									Total	Affected
Punjab	92 040	1 903	1 534	369	19.0	2.14	0.1	0.02	35	29
Sind	41 142	29 330	19 604	9 728	33.0	2.89	2.4	0.71	23	23
KPK	21 806	17 451	13 794	1 664	10.0	2.77	2.8	0.80	24	24
F A T A	3 757	23 234	19 455	3 773	16.0	5.70	10.8	6.19	7	7
Balochistan	8 829	55 908	29 801	24314	43.0	7.46	8. 4	6.33	30	27
A J K	3 496	744	724	20	2.0	7.88	0.2	0.21	4	4
F A N A	1 375	-	-	-	-	-	-	-	-	-
I C T	1 056	-	-	-	-	-	-	-	-	-
Pakistan	173 500	128 570	84 912	39856	31.0	2.83	2.6	0.74	123	114

Table 4-Data Analysis by SPSS 16 and Significance of Annual Parasite Incidence (API) for the Year 2004 and 2007 Calculated by Paired T-test

Area	**Paired Differences in API**			
	2004 Mean ± SD	**2007 Mean ± SD**	**difference**	**P-value**
Punjab	0.53±0.05	0.24±0.03	0.29	0.001*
Sind	1.01±1.89	0.71±0.89	0.30	0.329
KPK	1.13±1.84	0.80±0.94	0.33	0.260
FATA	3.95±0.26	6.19±0.61	-2.24	0.000
Balochistan	4.22±2.59	6.33±1.27	-2.11	0.001
AJK	0.16±0.09	0.20±0.08	-0.04	0.350
Pakistan	1.60±2.35	2.08±2.80	-0.48	0.007

*highly significant

DISCUSSION

Data of all provinces and Pakistan for the year 2004 was compared with data for the year 2007 which gave very complex picture of Sind and KPK. In Sind 15 districts were endemic out of total 16 districts in 2004 and 23 districts were found endemic out of 23 in 2007. Number of positive cases for all types of malaria was 36447 in 2004 and reported 29330 in 2007 with p value 0.563. This situation showed horizontal increase of cases and vertically there is decreasing trend but this result is not showing significant statistical values. In KPK 18 districts were endemic out of total 24 districts 2004 and 24 districts were found endemic out of 24 in 2007. Number of positive cases for all types of malaria

was 23834 in 2004 and reported 17451 in 2007 with p value 0.380. There is same observation on data of KPK. In Punjab 33 districts were endemic out of total 34 districts 2004 and 29 districts were found endemic out of 35 in 2007. Number of positive cases for all types of malaria was 4413 in 2004 and reported 1903 in 2007 with p value 0.028. In Punjab disease incidence decreased horizontally and vertically with significant statistical values. In Pakistan 91 districts were endemic out of total 105 districts 2004 and 114 districts were found endemic out of 123 in 2007. Number of positive cases for all types of malaria was 111781in 2004 and reported 128570 in 2007 with p value 0.000. Pakistan data also showed horizontal and vertical increase of disease incidence with significant p value. Hence, on the data of Punjab any future decision can be safely made.

Therefore possibility of malaria elimination in Punjab Province is a reality, providing that additional efforts and inputs in terms of resources both financial and human are made available. Ecological changes favoring reduced level of malaria transmission "Green revolution" in agriculture through improved water management due to scarcity of water, resulting in drastic reduction of breeding sites, introduction of practices of intermittent irrigation for rice, leveling of rice and cotton fields, cementing of edges of irrigation canals preventing water leakages, introduction of high-yielding varieties of cotton and rice with the large-scale deployment of pesticides and alike. There is an abundance of eucalyptus trees (known for its ability to extract water from underground thus reducing water table) and neem trees (known for its leaf mosquito repellent action) throughout the province, on which local industry of paper mills is based. Literacy rate of population of Punjab province is higher than in any other province of Pakistan, which could be beneficial for implementation of the awareness campaign particularly in pre-elimination stage of malaria elimination programme. Socio-economic status of population of the Province is somewhat superior to any other province, allowing the local population to allocate more money for purchasing individual means of protection from mosquito bites.

CONCLUSION

It is concluded that factors are favoring malaria elimination in the province of Punjab, Pakistan because there is a strong political commitment on the part of the provincial and federal Governments, efficient and motivated staff of the malaria control programme in the province is available, reliable malaria diagnosis service at various levels of the malaria control programme is existed and recently highly efficacious tools of treatment "ACT for P.falciparum and 14-day primaquine for P.vivax has been introduced. Provincial malaria control programme is capable to almost immediately respond to emergency situation and has already demonstrated success in dramatic reduction of overall malaria incidence during the last few years. Hence, programme should adapt the elimination strategy to target the P.falciparum malaria first and subsequently eliminate P.vivax.

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