A REVIEW OF MALARIA IN IRAN, 1975–90

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ABSTRACT. Since 1958, when the malaria eradication program officially started in Iran, great strides has been made in controlling the disease in most of the country. However, because of certain technical, operational and administrative problems, malaria is still highly prevalent in southeastern Iran, affecting 6% of the population. The situation of malaria in Iran from 1975 through 1990 is discussed in detail, with particular emphasis given to the epidemiological characteristics and vector transmission factors in each region of the country.

INTRODUCTION

Since the end of the 19th century, when Ross discovered the transmission of malaria by anopheline mosquitoes, extensive studies have been carried out on the epidemiology and control of this disease throughout the world. However, malaria is still the most important heath problem in many parts of the globe. According to the report by the World Health Organization (1990), more than 5.059 million cases of malaria were reported worldwide in 1988. Based on this report, about 59% of the world population (5.061 billion in 1988) were living in areas where malaria never existed or disappeared with or without the implementation of control campaigns, and the malaria-free status has been maintained. Thirty-two percent were living in areas where endemic malaria was reduced or eliminated, but transmission has recurred or intensified and the situation is unstable or deteriorating. This latter area includes zones with the most severe malaria problems (comprising 1% of the world population) which developed following major ecological or social changes. In the same year the World Health Organization (1990) reported that 474 million people were living in areas where endemic malaria has remained virtually unchanged and no national malaria program has ever been implemented. The estimate of malaria cases worldwide, as indicated above, does not include Africa south of the Sahara, where the incidence of the disease has been estimated to be about 250 million.

Over the past 70 years in Iran, numerous researchers have worked on malaria which still constitutes one of the most important health problems of the country. Gilmour (1925) was the first to report on the malaria situation in Iran as a part of his comprehensive report on the endemic diseases of the country to the League of Nations. He had estimated that 60% of the country's total population (12 million in 1921) were living in areas where malaria was highly endemic and 4–5 million cases were occurring each year. According to Gilmour, 30–40% of the country's total deaths were due to malaria and one-third of the Ministry of Health's budget was allocated for the purchase of the antimalarial drug quinine.

Latisheve (1921), Lindberg (1936), Amidzadeh (1941), Zolotarev (1945) and Macan (1950) studied the epidemiology of malaria in Iran, followed by Jalali (1955), Motabar et al. (1975), Manouchehri et al. (1972, 1974a, 1974b, 1975a, 1975b, 1976a, 1976b). Manouchehri and Janbakhsh (1977), Manouchehri and Yaghoubi-Ershadi (1988), Zaim (1987) and Zaim et al. (1991) summarized the malaria situation in the country and studied the technical and operational difficulties facing malaria control programs.

In 1958, Iran started the national malaria eradication program. This strategy, however, officially was changed to malaria control in 1987 because of the existence of serious technical problems and administrative difficulties. Nevertheless, malaria eradication has remained as the "final aim" in Iran, because of its overall impact on health and its socioeconomic benefits.

Iran is presently divided into 3 epidemiological zones of malaria: 1) areas north of the Zagros Range of Mountains, 2) areas south of the Zagros Range of Mountains, including: 2-A) west and southwestern Iran and 2-B) the southeast corner. From 1975 to 1990, various aspects of the malaria situation in Iran are presented according to the 3 specified epidemiological zones.

1. Areas north of the Zagros Mountain Range: The Annual Parasite Incidence (API) in this area (which includes the provinces of Gilan, Mazandaran, East and West Azerbaijan, Zanjan, Markazi, Teheran, Yazd, Khorasan, Semnan, Isfahan and the temporate zones of Kerman, has fluctuated between 0.09 and 0.15 per one thousand population between 1968 and 1975 (Manouchehri and Janbakhsh (1977).

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Table 1. Malaria cases reported in the epidemiological zones of Iran (1975–90).

Year	Zone 1*		Zone 2*		Zone 3*		Total malaria cases
	Population (Thousand)	Malaria cases	Population (Thousand)	Malaria cases	Population (Thousand)	Malaria cases	
1975	22,474	3.135	9,440	15,086	1,373	17,145	35,366
1976	22,890	4,471	9,508	11,858	1,477	35,687	52,016
1977	22,756	3,899	9,245	10,772	1,591	40,811	55,482
1978	23,181	1,724	9,410	7,926	1,593	19,942	29,592
1979	23,511	904	9,543	7,713	1,606	13,199	21,816
1980	24,568	1,276	10,156	10,937	1,686	21,376	33,589
1981	25,213	1,977	9,832	11,007	1,791	15,928	28,912
1982	27,436	2,725	10,532	10,363	1,903	30,516	43,604
1983	29,273	4,098	12,119	9,639	2,008	32,027	45,764
1984	31,493	4,760	11,771	6,937	2,174	19,440	31,137
1985	32,545	5,309	12,344	4,935	2,226	15,480	25,724
1986	33,193	5,762	12,567	3,375	2,354	25,292	34,429
1987	34,475	5,608	13,958	2,965	2,592	28,476	37,049
1988	35,540	4,183	14,546	2,075	2,655	47,061	53,319
1989	35,815	4,359	15,457	1,602	2,771	52,527	58,488
1990	38,733	4,220	14,774	1,383	2,906	74,056	79,659

* Zone 1: North of the Zagros Mountain Range.
Zone 2: Western and southwestern Iran.
Zone 3: Southeastern corner of Iran.

In 1975, epidemiological studies carried out in this area (with a population of 22.4 million) revealed that out of 2,904 cases of malaria investigated, 32.1% were indigenous and the remainder were relapsed (8%), imported (56.9%) and introduced (1.9%). However, surveys between 1976 and 1990 have revealed the API has been fluctuating between 0.038 and 0.195 (Table 1, Fig. 1), with a decline in the rate of indigenous cases. Epidemiological studies in 1990 have shown that out of 4,076 cases of malaria investigated, 89.6% were imported and only 2% were indigenous cases (Table 2). On average, 92.6% of the cases have been due to *Plasmodium vivax* and the remainder due to *P. falciparum* (6.1%), *P. malariae* (0.5%) or mixed (0.8%) (Table 1).

During the past 16 years, an average of 2,803 imported cases of malaria (mainly from Afghanistan, Pakistan and Bangladesh) have been reported annually in this zone. These imported cases have been considered responsible for an average of 74 introduced cases each year (Table 2). The timely detection and treatment of cases, as well as selective indoor residual spraying with DDT, usually has stopped transmission. No major health problems have arisen in this part of the country where extensive indoor residual spraying for malaria control was discontinued in 1968 (Manouchehri and Janbakhsh 1976). An average of 8 cases of induced malaria from blood transfusions also have been reported annually in this zone during the specified period (Table 2).

The API showed a sharp increase after 1979, which coincided with Soviet occupation of Afghanistan and the immigration of Afghan refugees to Iran. Moreover, a sharp decline in the Annual Blood Examination Rate (ABER) in this zone occurred after 1984, which coincided with the integration of malaria control units into the primary health care system.

2. Areas south of the Zagros Range of mountains: The outcome of malaria control programs in area south of the Zagros Range of mountains (including epidemiological zones of 2-A and 2-B as previously described with a population of 17.6 million) has been variable. In general, the results of such campaigns have not been as expected or have deteriorated to some degree. These results can be attributed to a variety of factors, including: 1) resistance of *Anopheles stephensi* Liston to DDT, dieldrin and malathion (Mofidi et al. 1958, Mofidi and Samimi 1960 and Manouchehri et al. 1976a) and *An. culicifacies* Giles to DDT (Manouchehri et al. 1975b), 2) exophilic habits of some of the vectors (e.g., *An. superpictus* Grassi and *An. fluviatilis* James), 3) factors related to human behavior (including outdoor sleeping habits, relative inaccessability of some localities, reluctance of some communities to have their houses sprayed, movements of human populations), 4) weaknesses in the primary health care system, and 5) the long transmission season (9–10 months in some areas).

2-A. Western and southwestern Iran: This area (with a population of 14.7 million) includes

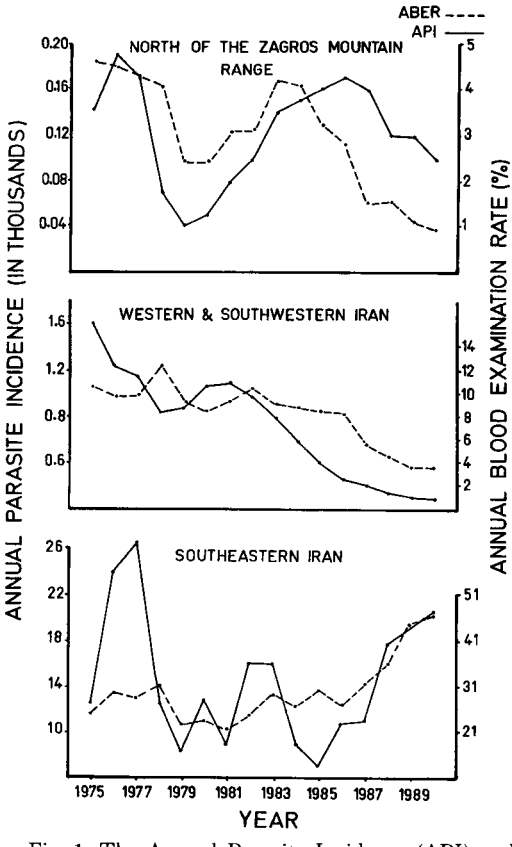

Fig. 1. The Annual Parasite Incidence (API) and Annual Blood Examination Rate (ABER) of malaria in the 3 epidemiological zones of Iran (1975–90).

the provinces of Kurdistan, Bakhtaran, Ilam, Hamadan, Luristan, Bushehr, Chahar-Mahal Bakhtiari, Kohkiluyeh and Bovir Ahmad and Fars.

In this zone (and in other areas where *An. stephensi* is present), indoor residual spraying with propoxur (2 g/m^2, 2 cycles per year), larviciding with Abate* and fuel oil, treatment of malaria cases, expansion of health infrastructure and socioeconomic improvements have yielded a marked reduction in malaria cases. The area now is considered to have low endemicity for malaria.

Indoor residual spraying with propoxur in this area, begun in 1978, has reduced drastically the population of the most important vector, *An. stephensi*.[2] The residual activity of this insecticide also has been relatively effective against the

[2] Saebi, M. E. 1987. The spatial distribution of anopheline mosquitoes of Iran. Ph.D. Dissertation, School of Public Health, Teheran University of Medical Sciences.

Table 2. Results of epidemiological investigations performed on reported malaria cases in 2 epidemiological zones of malaria in Iran (1975–90).

Year	Zone 1*: Number of reported cases						Zone 2*: Number of reported cases					
	Indigenous	Introduced	Induced	Imported	Relapse	Unknown	Indigenous	Introduced	Induced	Imported	Relapse	Unknown
1975	932	54	15	1,652	232	19	842	191	5	742	746	34
1976	343	385	21	2,888	572	76	585	211	13	841	670	23
1977	61	68	12	3,088	470	24	624	45	2	1,061	741	25
1978	31	45	7	1,396	121	3	556	49	11	793	614	22
1979	211	5	3	591	65	2	510	59	3	469	381	10
1980	87	31	4	884	130	8	1,478	88	0	527	626	48
1981	37	28	11	917	156	12	1,153	84	7	607	9,027	124
1982	123	53	6	2,287	190	9	1,343	69	0	660	724	107
1983	38	169	7	3,440	103	12	1,091	16	0	918	815	52
1984	44	33	13	3,715	164	32	605	106	30	921	451	49
1985	244	36	9	4,563	142	15	481	24	0	1,341	509	25
1986	378	41	3	4,279	317	4	267	69	6	929	237	23
1987	428	43	1	4,706	174	9	273	24	2	999	123	28
1988	574	69	7	3,125	160	19	172	36	2	213	85	15
1989	256	21	0	3,665	284	24	133	16	3	165	73	7
1990	83	99	1	3,654	225	14	158	14	0	157	48	9

* Zone 1: North of the Zagros Mountain Range.
Zone 2: West and southwestern Iran.

secondary vectors *An. fluviatilis and An. superpictus* (Faghih 1969). The API consistently has dropped in this area in recent years even though a large part of this area was located in the war zone during 1980–88. The API reached its lowest point (0.09 per one thousand population) in 1990 (Table 1, Fig. 1), with only 1,383 malaria cases reported. More than 90% of the cases always have been caused by *P. vivax*. The ABER also has dropped in the past 4 years, which is attributed mainly to the integration of malaria control programs into the primary health care system (Fig. 1), which requires that blood samples are taken only from those person suspected of malaria.

Based on epidemiological investigations carried out in this area during the past 16 years (Table 2), an average of 642 cases of indigenous malaria, 709 cases of imported and 69 cases of introduced malaria have occurred each year. In this zone, between 0–30 cases of induced malaria, caused by blood transfusions, also have been reported annually.

2-B. Southeastern corner of Iran: This area (with a population of 2.9 million) includes the provinces of Sistan and Baluchistan, Hormozgan and the tropical areas of Kerman Province, and is characterized by "refractory malaria."

Anopheles stephensi is the primary vector of malaria in Hormozgan Province. However, in Sistan and Baluchistan, where it was once one of the most important vectors, *An. stephensi* responded well to indoor residual spraying. Currently it is *An culicifacies* which predominates as the vector of malaria in Baluchistan. The partially exophilic habits of the latter species, recently investigated in Baluchistan have made *An. culicifacies* the most common vector in the area (Zaim, unpublished data). In the southeastern corner of Iran, three secondary vector species (*An. dthali* Patton, *An fluviatilis* and *An. superpictus*) also are present. The above mentioned factors, combined with the following factors, are considered responsible for refractory malaria: 1) the great dispersion of villages, 2) weakness of the primary health care system, 3) shortages of trained personnel, 4) low socioeconomic/health status of local communities, 5) high illiteracy rates, and 6) administrative shortcomings and financial stringency.

In 1990, the API reached its highest level of 25.5 per one thousand population in 13 years (Fig. 1). There have been pronounced peaks in the API nearly every 6 years. The lowest API during the past 16 years (observed in 1985) has been 6.95 per one thousand population (Fig. 1).

On average, 65% of the reported cases of malaria in the southeastern corner of Iran have been due to *P. vivax*. During the past 16 years the average ratio of *P. falciparum* to *P. vivax* has been 0.42:1. However, during 1979, 1980 and 1990 this ratio was reported to be 0.93:1, 1.15:1 and 1:1, respectively.

The ABER has increased fairly consistently since 1979, reaching its highest value (64.6%) in 1990. This rate reflects the great attention which has been devoted to case detection. In recent years, the noticeable spread of cloroquine-resistant *P. falciparum* in southeastern Iran is demanding great attention to planning, supervising and properly treating malaria cases (Edrissian et al. 1987a, 1987b; Edrissian 1989).

CONCLUSION

Malaria has become well controlled in most of the country. Only in the southeastern corner of Iran, because of the previously indicated reasons, have malaria control programs not achieved their goals. It is hoped that more success in malaria control in southeastern Iran will be achieved through greater investments in training and research as well as expansion of the health care infrastructure in the near future.

ACKNOWLEDGMENTS

We gratefully acknowledge Dr. A. Mesdaghinia, Dean, School of Public Health, Teheran University of Medical Sciences for his valuable technical assistance. We also are indebted to Dr. R. A. Ward, Editor, Journal American Mosquito Control Association for helpful suggestions and critically reviewing the manuscript.

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