Epidemiology of Malaria in Qom Province 2007- 2009

Yaser Tabaraei[1],Shahnaz Shirbazo[2], Abolghasem Siyadatpanah[3], Saeid Khodadadi[4], Jebreil Shamseddin[5],Fatemeh Tabatabaie[5*]

[1] MS in Biostatistics, Public health School-Health School-Sabzevar university of medical sciences (SUMS), Sabzevar, Iran
[2]School of Medicine, Baqiyatallah University of Medical Sciences, Tehran, Iran
[3] MSc in Medical Parasitology, Amol Faculty of Paramedical science, Mazandaran University of Medical Sciences, Sari, Iran.
[4] Qom Azad University of Medical Sciences, Qom Branch Islamic Azad University, Qom, Iran
[5] *Department of Parasitology and Mycology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
*Corresponding Author: fatemeh_tabatabaie@yahoo.com, f-tabatabaei@tums.ac.ir

Abstract: Malaria is a tropical and semi-tropical parasitic disease, which is native to some countries including Iran. In recent years, owing to various factors including the overuse of insecticides in agriculture and decreased fund allocated to the disease in the world, the prevalence of malaria has increased. Similar to many developing countries, Iran has some problems in this respect. Every year, some cases of the disease are reported in Qom province. Therefore, it is important to determine the epidemiological status of the disease in the province. This descriptive cross-sectional study was performed during 2007- 2009. Diagnosis of the disease was based upon clinical examination and microscopic evaluation of thick and thin peripheral blood smears. Microscopic observation of the parasite in the smear was performed after smear staining. The demographic data, and clinical and laboratory findings were recorded in the patients' datasheet. The data were analyzed using chi square test and t-test. The frequency of malaria cases in 2008 had an increasing trend, compared with the previous year. Most cases occurred during the peak activity period of Anopheles mosquito; from June to October. The infection has occurred mostly in males, in the age range of 16-25, and in urban population in immigrants (Afghan immigrants). Moreover, the highest prevalence was related to *Plasmodium vivax*, and the most common accompanying symptoms were chilling, and then fever, nausea and vomiting, and generalized pain. Following the care measures and applying regional malaria fighting procedures, would control the disease.

Keywords: Malaria**;** Qom province; Epidemiology; *Plasmodium vivax*; Anopheles

Introduction:

Malaria is a tropical and semi-tropical parasitic disease around the world, which is considered a major public health problem. Almost one half of the world population is at the risk of malaria. Moreover, each year 200-300 million cases of malaria are reported from almost 90 countries, among which 1-3 million cases of the infection lead to death. More than 80% of the infection and death of malaria occur in Africa, Latin America, and Asia. The disease is caused by the protozoa, *Plasmodium*. Four species of *Plasmodium* are pathogenic for human; namely *Plasmodium vivax*, *P. falciparum*, *P. ovale*, and *P. malariae*. Among the species, *P. falciparum* causes the most severe cases, while *P. vivax* is responsible for majority of the cases. Iran lies down the northern temperate zone between latitudes 25 degree north and 39 degree 47' north and between longitude 44 and 64 degree east. They country has various climate conditions, and is considered as one of the endemic countries for malaria. The people living along the northern coastlines of the Caspian Sea and the coastlines of the Persian Gulf and the Oman Sea have suffered great loss due to the disease since thousands of years ago. Now, after more than 50 years of continuous fighting against malaria in Iran started in 1956, malaria is still considered as an acute health concern mainly in south and south east of Iran in Kerman, Hormozgan, and Sistan-va Baluchestan provinces. By applying the health measures, the prevalence of the disease has reported from 96000 cases in 1999 to 77000 cases in 1992, and 65000 cases in 1993 (1- 5). In 2000 and 2001, the incidence rates of malaria in Iran were 19700 and 17758 cases, respectively. However, it should be considered that there are more than seven species of Anopheles mosquito as the vectors of the disease in many parts of the country. Moreover, the status of malaria is unstable in many areas, particularly along the eastern borders of Iran, through which large

number of immigrants pass. Considering these facts, malaria is still prevalent in many areas, and the immigration is considered a major problem in the disease control. Also, there are not rigid and stable regulations with regard to the quarantine and control of such border passing. As a result, in 1993, more than 88% and 11% of the 8200 cases of imported malaria cases were from Afghanistan and Pakistan, respectively. Although the north Zagros region has lower risk for malaria compared to the south Zagros, the potentially unstable conditions along the west and northwest borders can be a risk factor for re-emergence of the disease in such regions, particularly along the borders. In spite of considerable achievements in fighting malaria in Iran, several cases of the disease are reported each year (5-7). The major parameters in epidemiology of malaria are the immunological and genetic structure of the population at risk, type of the parasite and mosquito present in the high-risk area, level of rainfall, temperature, distribution of feeding sites of the mosquitos, use of anti-malaria drugs, and other agents used for reducing the disease transmission (1, 2). This study was performed to evaluate the status of malaria disease and determination of various epidemiological aspects of the disease in the area with regard to the geographical and climate conditions, and also availability of the circumstances for transmission and completion of the parasite life cycle. Having a clearer image about the various aspects of the disease throughout the country is an important factor in the national control of malaria.

Methodology:

This is a descriptive cross-sectional study. The data were collected based on the report datasheets of nine health centers of Qom province (Imam, Imam Hassan Askari, Zahra, Jafarieh, Hajji Abad, Dastjerd, Mosque, Central, and Kahak). All the files related to the years of study were investigated, and the data were gathered according to census method. In the case finding program, according to the endemicity, a specified number of families was considered for each health center. Then, the families were randomly selected and their peripheral blood smears were obtained at home (active case finding). Moreover, blood smears were prepared for those who presented with fever and chilling (passive case finding). All samples (thick and thin smears) were sent to the laboratory, and the samples were evaluated under light microscopy at 100X magnification. The positive cases were determined. Then, the characteristics related to the patients and the disease including patients' age, sex, symptoms, and residence place; the *Plasmodium* species, and the time and place of infection were recorded in patients' datasheets.

Results:

Frequency of malaria in Qom province during 2007-2009:The number of malaria cases in 2008 increased compared to that in 2007, but the number decreased in 2009. According to our findings, in 2007 there were 12 positive cases of malaria, while the number was 23 and 17 for 2008 and 2009, respectively. The number of individuals referred to the health centers were 180, 240, and 200 in 2007, 2008, and 2009, respectively. Frequency of the cases fluctuated in various months of the year. For instance, in 2007, the peak incidence was observed in June and October; 25% in each month, while in 2008, the highest rate was observed in September (26%). In 2009, the monthly frequency of malaria was 13% of the annual rate from July to September. With regard to the residence place, in all the three years of study, 100% of the positive cases occurred in urban population.

The disease frequency was higher in men; 82.4% of the cases were male. The frequency of malaria in men was significantly higher than that in women ($p<0.001$).The highest frequency of the disease was observed in the age group 16- 25, and then in 26- 40, 0-5, and 40- 60. No positive cases were observed in the age group above 60. The mean age of the patients was 20.57 ± 12.76 years.The analysis showed that there was a statistically significant relationship between the frequency of malaria and the mean age ($p<0.001$). Within the three years of study, all positive cases of malaria were observed among immigrants; mostly Afghans, Pakistanis, and then Iraqis. Considering the parasite species, the most common species was *P. vivax*. The highest rate of *P. vivax* infection was observed in 2008 (95.7%), and the highest rate of mixed infection of *P. falciparum* and P. *vivax* occurred in 2009 (9.5%).

Discussion:

Malaria is caused by obligatory intracellular protozoa of genus *Plasmodium*. The malaria parasite grows and propagates in red blood cells (RBCs). The parasite finally ruptures the infected RBCs and causes the disease symptoms. Malaria is one of the major blood-borne parasitic diseases, which is transmitted through the bite of female Anopheles mosquito (3). Epidemiology of malaria and its major determinant factors are rather complicated and variable even within a specific geographical region. Factors such as immunological and genetic structure, the population at risk, parasitic species, humidity and the annual rainfall, temperature, distribution of the mosquito development sites, using anti-malaria drugs, and the prevention measures are effective in the disease rate and the parasite transmission rate (8).

Table 1. Characteristics of samples during 2007-2009

Characteristics		2007	2008	2009
Nationality	Iranian	0	0	0
	Immigrants from Afghanistan, Pakistan, and Iraq	100	100	100
Sex	Male	25.0%	8.7%	25.0%
	Female	75.0%	91.3%	75.0%
Birth location	Urban	100	100	100
	Rural	0	0	0
Species	*P. vivax*	83.3%	95.7%	94.1%
	P. falciparum	2.0%	4.3%	0.0%
	mixed	0.0%	0.0%	5.9%
Age group	<5	17%	17%	25%
	6-15	8%	9%	25%
	16-25	33%	39%	25%
	26-40	42%	22%	25%
	40-60	0%	13%	0%
	>60	0%	0%	%0
Month	April	0%	0%	6%
	May	8%	4%	13%
	June	25%	8%	6%
	July	8%	9%	13%
	August	8%	8%	13%
	September	8%	26%	13%
	October	25%	17%	13%
	November	8%	9%	8%
	December	17%	13%	8%
	January	0%	4%	6%
	February	0%	0%	6%
	March	8%	8%	0%

Zagros Mountains as a presumed line from northwest of Iran to its southeast, obliquely divide the country into two parts in the north and south of the mountain chain. Malaria is a major health problem mainly in the south of the line, and the disease in under control in the north part. However, this does not mean that the disease cycle is completely broken down. The uncontrolled immigration of refugees from surrounding countries such as Afghanistan and war in these countries has increased the rate of imported cases.With respect to the malaria occurrence trend in recent years, it can be concluded that the case finding and reporting system was efficient, but immigration of Afghans and Pakistanis due to wars, and the uncontrolled immigration into the country from malaria endemic countries surrounding Iran have increased the frequency of malaria in Iran in some recent years. Furthermore, travelling to southeast regions of the country that are considered to be endemic for malaria is another reason for increased frequency of the cases in some years. With regard to its appropriate climate condition for the vector and parasite and its appropriate climate pattern for the disease transmission, the current study was carried out in the Qom province to evaluate the malaria epidemiology in the region. According to our results, the disease had a decreasing and then increasing rate within the years of study. Malaria is not currently a major health problem in the Qom province. However, it should receive attention, because the region is appropriate for the disease transmission cycle owing to its suitable climate condition for growth and development of the vectors. Moreover, the parasite reservoirs, particularly Afghan patients, as well as the susceptible hosts are abundant in the area. It is possible that not paying enough attention to the problem leads to completion of the parasite life cycle, and emergence of new focal points of malaria in the Qom province, just as happened in other provinces in recent years. In 2009, 5921 cases of malaria were reported. The number of positive cases has fluctuated in the past 30 years, such that the incidence peaked in 1977 and 1991, and from 1991 to 2002, the trend was decreasing. Then, from 2006 on, a decreasing trend was observed in incidence of the disease. The ratio of

P. falciparum has decreased from 15% to 8.5% in 2007. Among 119 cases of malaria hospitalized in the infectious disease ward of Tehran University of Medical Sciences, 103 and 14 cases were infected with *P. vivax* and *P. malariae*, respectively, and only two cases were infected with *P. falciparum*. Thus, *P. falciparum* is rarely reported. During 2000 to 2002, 50% of the malaria cases were Iranians, which increased to 70% in 2003. Among the reported cases, 85% were from Siatan-va Baluchestan, Hormozgan, and Kerman provinces, and 65% of the cases were reported from Sistan-va Baluchestan province. The malaria cases caused by *P. falciparum* in Sistan-va Baluchestan province are mainly from the southern towns of the province. In Hormozgan, 90% of the cases were caused by *P. vivax*. In temperate endemic areas, the pathogen is mostly *P. vivax*, and summer is the season of transmission. In subtropical areas, *P. falciparum* is observed as well as *P. vivax*. In tropical areas, the disease transmission is observed in all seasons, and *P. falciparum* and *P. vivax* are the most common species observed. In the current study, the most common symptoms were chilling and fever. In the study carried out by Robinson et al., the prevalence of chilling was higher in *P. vivax* infections compared with *P. falciparum* cases. According to the World Health Organization (WHO) report, in 1993, 41% of malaria cases reported in Iran were caused by *P. falciparum*, and almost 99% of the *P. falciparum* cases occurred in Afghan, Pakistani, and Iraqi immigrants. In analysis of the data reported from Kashan in previous years, it was shown that the highest frequency of the disease occurred in the age range of 20- 29, who were mostly Afghan males. Moreover, most cases were caused by *P. vivax*. In the study carried out in Bushehr, it was observed that the largest portion of the patients were male Afghans in the age range of 20- 29 (3, 9- 12). Furthermore, in the studies carried out in Gabon and Gambia, the frequency of malaria was higher in men. In the study performed in New Guinea, most malaria patients were around 15 years old. The studies carried out in Gambia demonstrated that malaria mostly occurred in immigrants and travellers (13- 15). During 1999-2000, the number of malaria cases in Italy was 2060, all of which were imported cases. Among the cases, 93%, 4%, and 3% were imported from African, Asian, and Latin American countries, respectively. From 1971 to 1985, the number of imported malaria cases in Europe increased from 1000 to 7000 cases. In the USA, three local epidemics of malaria occurred in highly populated regions, which indicate the persistence of the risk of malaria transmission through Anopheles mosquito (16, 17). The results obtained indicated that the highest incidence of malaria occurred in the activity period of the mosquito (June to October). The disease mostly occurred in urban population, among males in the age range of 16- 25, and most cases were of the imported type (among Afghan immigrants). Most cases were caused by *P. vivax*, and the most common accompanying symptoms were chilling, fever, nausea, vomiting, and generalized pain. The findings can be explained by higher rate of remaining in one place and having lower exposure to the disease in women, and the higher rate of immigration and mobility in male workers due to the issues occurred in neighboring countries. Therefore, training the people about the disease, paying attention to the problems of the refugees along the borders and quarantining them as well as considering the transmission routes of malaria and the methods of fighting the disease can be helpful in controlling the disease. Moreover, the social changes in neighboring countries, and evaluating all Iranian and non-Iranian travellers and immigrants who come from the malaria endemic regions should be considered. In addition, the environmental changes and the technical, political, executive, and economic problems of malaria fighting programs should receive appropriate attention. The disease can be persistently controlled by active case finding, continuous investigation of Anopheles mosquitoes from the viewpoint of entomology, residual insecticide spraying, and killing the larvae. In our country, correct diagnosis and timely treatment are the keys to the disease control.

References:
1- B. L. J Chwatt. History of malaria from prehistory to eradication. In: Malaria principles and practice of malariology. Wernsdorfer WH and Mac Gregor IA (Eds), Churchill Livingstone: London (1988) 1-59
2- W. J. G Nicholas and Breman. Malaria and babesiosis In: Harrison's principles of internal medicine. 14th ed. New York (1998) 1180-89.
3- E Saebi. Parasitic diseases in Iran. 2nd Edition. Aeezh Pub. 2009.
4- Center for Disease Control and Prevention. 1999. The malaria fighting program. 1- 10.
5- M Zaeem. Kashan mosquito faunas and its importance with regard to human health. International Desert Research Center. 1986: 17, 8- 14.
6- M Rouhani. Epidemiological evaluation of 3532 cases of imported malaria cases to Khorasan province in five years (1986- 1990). Journal of Faculty of Medicine, Mashhad University of Medical Sciences. 1993: 36 (43-44): 62-72.
7- B Naghili. Clinical and epidemiological evaluation of malaria in East Azerbaijan province. Journal

of Tabriz University of Medical Sciences, 1993: 27 (20) 73- 85.

8- K. J Isselloucher. et al. Harrisons principles of internal medicine 13ᵗʰ ed. New York, McGraw-Hill, 1994, Vol. 1, 887-9.

9- P Robinson, AM Jenney, M Tachado, A Yang, J Manitta, K Taylor, et al. Imported malaria treated in Melbourne Australia: epidemiology and clinical features in 246 patients J of travel medicine, 2001 mar-Apr 8 (2) 76-81.

10- M Zaim. Malaria control in Iran: present and future. J Am Masq control Assoc1987, 3 (3): 392-96.

11- WHO World malaria situation in 1993.Geneva: WHO 1996

12- A Dorudgar., R Dehghani., H Hushiar., M Sayah. Epidemiology of malaria in Kashan. Journal of Gilan University of Medical Sciences. 1999: 8 (31, 32).

13- E Wildling., S Winkler., P. G Kremsner., C Brandts., L Jenne., W. H Wernsdorfer. Malaria Epidemiology in the province of Moyen Ogoov, Gabon.Trop.Med.Parasitol, 1995 , 64 (2), 77-82.

14- B Genton., F Al Yaman., H. P Beck., J Hii., S Mellor., L Rare., M Ginny., T Smith., M. P Alpers. The epidemiology of malaria in the Wosera area East Sepik province Papua New Guinea, Ann Trop Med Prasitol, 1995, 89 (4) 377-90.

15- B. M Greenwood., H Pickering. A malaria control trial using insecticide-treated bed nets and targeted chemoprophylaxis in a rural area of the Gambia ,west Africa Trans R Soc Trop Med, 1993, 87 (2) 3-11.

16- R Romi., D Boccolini., G Majori. Malaria incidence and mortality in Italy in 1999-2000. Eur Survei 2001; 6 (10): 143-47.

17- JR Zucker. Changing pattern of autochthonous malaria transmission in the United States: a review of recent outbreaks. Emerging Infect Dis 1996; 2 (1): 37-43.

1/17/2013