Encyclopædia Iranica

Article by **Mohammad Hossein Azizi**

Published: October 4, 2016
Last Updated: October 14, 2016

MALARIA

MALARIA (Per. [*tab o*] *nowba* تب نوبه, *mālāriā* مالاریا), one of the most significant mosquito-borne, infectious diseases, which has been a challenging health dilemma for centuries. Its causative agent remained unidentified until the last decades of the nineteenth century, and effective synthetic anti-malarial medications were unavailable until the mid-twentieth century. According to the World Health Organization (WHO) in 2013, Iran, after several decades of fighting against the disease, has now entered the pre-eliminated stage of malaria control. It is anticipated that, by 2025, malaria will be completely eradicated in Iran.

History. Malaria is a parasitic disease transmitted by the bite of an infected Anopheles mosquitoes (White and Breman, 2010, p. 177). In the eastern Mediterranean region, and also in Iran and Afghanistan, eighteen species of Anopheles mosquitoes are vectors for malaria (Anderson). An illness with symptoms similar to malaria is thought to be mentioned in the *Avesta*, as equivalent to Persian *tab-larza*, meaning fever and chill (Najmābādi, p. 112, following the Pahlavi rendering of *Vendidad* 7.57 *tafnušča ... sārastišča* as *tab ... tab ī sard*; Anklesaria, 1949, p. 179). Malaria, as a clinical concept, has appeared in the works of well-known Persian physicians. ʿAli b. Sahl Rabbān Ṭabari (838-870 CE) in *Ferdows al-ḥekma* (Paradise of wisdom) portrayed a clinical picture of fevers, including the febrile condition of malaria (*Ferdows al-ḥekma* I, p. 319).

Various aspects of fevers with malaria-like symptoms are also discussed in Abu Bakr Rabiʿ b. Aḥmad Aḵawayni Boḵāri's *Hedāyat al-motaʿallemin fi'l-ṭebb*,

the oldest known medical Persian treatise, most probably written prior to 983-4 CE (Sajadi et al., pp. 976-80; Minovi, pp. 497-510). Clinical manifestations resembling the fever pattern of malaria are also described in Abu Bakr Moḥammad b. Zakariyāʾ Rāzi's (865-925 CE) *al-Ḥāwi* (Rāzi, XXI). Similar manifestations of malaria appear in ʿAli b. ʿAbbās Majusi Ahvāzi's (10th century CE) *Kāmel al-ṣenāʿat al-ṭebbiya*, as *tab-e nāʾeb* (intermittent fever; Najmābādi, p. 462), and in Avicenna's *Qānun fi'l-ṭebb* (Canon of medicine), as *tab-e nowba* (*Qānun fi'l-ṭebb*, pp. 105-8). Mention should also be made of Zayn-al-Din Esmāʿil Jorjāni's *Ḏaḵira-ye ḵʷārazmšāhi* (Treasure of the Ḵʷārazmšāh), the largest encyclopedia of Galenic medicine in Persian, in which different types of fever, including those with symptoms close to malaria, are delineated (*Ḏaḵira-ye ḵʷārazmšāhi*, 2005, pp. 128-51).

Malaria in the world and in Iran during the 19th and 20th centuries. As was the case with many infectious diseases, malaria was long regarded as an environmental disease caused by "bad air" (Harrison, p. 135). The "bad air," or miasma theory of malaria's origin, was an acknowledged hypothesis in the 19th century (Hempelmann and Krafts, 2013, p. 2). The causative agent of the disease remained unidentified until the very last decades of the 19th century, while effective synthetic anti-malarial agents were not manufactured until the mid-twentieth century (Meshnick and Dobson, 2010, pp. 15-24).

Malaria in Iran, as in many Middle and Far Eastern countries, has long been one of the main health problems with economic impacts (Palmquist and Aldridge, 1954, p. 976). Limited published data exists on malaria outbreaks and its prevalence in Iran in previous centuries. In 1604, during the era of the Safavid king, Shah ʿAbbās I, several thousand Armenians of the southern Caucasus were forced to immigrate to Iran (Matthee, 2012, p. 178). During one of these mass migrations, it is reported that a large group of immigrants died due to the outbreak of malaria en route from Ganja to Ardabil (Ṣāʾebi, pp. 237-50; Ḵuzāni Eṣfahāni, 2015, p. 907).

In the Qajar period (1796-1925), malaria was highly prevalent along the Caspian Sea, as well as in Khorasan, Azarbaijan, Kurdistan, Kermanshah, Hamadan, and Khuzestan. Additionally, the Persian Gulf territories were highly affected (Floor, p. 14; *Gozāreš-e Edāra-ye Ṣeḥḥiya-ye Jāmeʿa-ye Melal, 1976*, p. 101). At that time, the primary factors responsible for the high incidence of malaria, particularly in rural areas, were the lack of adequate sanitation and the presence of stagnant water, which resulted in the pervasive breeding of the vector of malaria, the Anopheles mosquitoes. The mosquitoes

were so common in certain areas that their presence contributed to unintended population migrations (*Gozāreš-e Edāra-ye Ṣeḥḥiya-ye Jāmeʿa-ye Melal*, pp. 65-66).

Modern insight regarding fatal diseases, including malaria, was gradually introduced into Iran after the foundation of the Dār al-Fonun in 1851. In 1882, a medical book in Persian compiled at the Dar al-Fonun by Mirza Abu'l-Ḥasan Ḵān-e Doktor was published as *Maṭlaʿ al-tebb-e Nāṣeri*. On the basis of European resources, various types of fevers, including the symptoms, origination, development, and diagnosis of malaria are described in the book (*Maṭlaʿ al-tebb-e Nāṣeri*, pp. 39-48). The Majles Library and Documentation Center houses the original lithograph of the book (Figure 1).

As observed by Jacob Eduard Polak, the Austrian professor of medicine and surgery at the Dār-al-Fonun, recurrent malaria outbreaks were usually initiated in mid-August, and without quinine treatment the mortality rate was high (Gächter-Jalilzadeh, p. 85). The first scientific investigation on malaria in Iran was carried out in the northern cities of Rasht and Anzali by the Russian researcher, N. I. Latishev, in 1921. As indicated by him, more than half of the people who lived in the affected rural areas had enlarged spleens due to malaria (Edrisiān, 2006, p. 1).

In 1924, 2,634 people contracted malaria in Tehran alone (*Gozāreš-e Edāra-ye Ṣeḥḥiya-ye Jāmeʿa-ye Melal*, 1976, p. 68). Hence, Dr. John Gilmour was invited by the Iranian government to investigate the malarial endemic areas. In 1925 he wrote the first official report on malaria in Iran. It was part of an inquiry on sanitary conditions and endemic diseases in Iran, and the results of this study were submitted to the League of Nations (Jāmeʿa-ye Melal). As indicated in the report, the estimated total population of Iran in 1921 was 12 million, of which around 60 percent resided in highly endemic malaria areas, and annually between 4 and 5 million people had contracted the disease, which was responsible for 30 percent to 40 percent of all mortalities in Iran. Consequently, the Ministry of Health had to invest around one-third of its annual budget to purchase quinine tablets for the treatment of the infected patients (Manouchehrian et al., pp. 38-84). The gross national product of Iran in 1924 was 23,686,425 tumāns, and overall expenditure was 22,414,297 tumāns, of which 136,370 tumāns was allocated to the national health sector (Puršālči, p. 241). In 1925, Dr. Ḥosayn Bahrāmi, Eḥyā-al-salṭana (b. 1885), the Head of the Ṣeḥḥiya-ye Koll-e Kešvar (Public Health Administration), sent three physicians—Dr. Abu'l-Qāsem Bahrāmi, Dr. Moḥammad Ḥosayn Adib,

and Dr. ʿAli Amir-Ḥekmat—to Italy to study malariology (Rustā'i. pp. 30-33).

Before World War II, a limited-scale malaria campaign was launched in Iran, mainly focusing on the distribution of quinine tablets among patients. Malaria preventive measures employed were the spraying of stagnant waters with petrol products and the promotion of basic sanitary standards. However, due to the lack of facilities, budget shortfall, and wartime shortages, these efforts were ultimately stopped (Moʿtabar, 2010, pp. 646-51).

There are numerous medical documents on file at the National Library and Archives of Iran, such as a letter from the Office of Public Health Administration (Ṣeḥḥiya-ye Koll-e Kešvar) regarding the distribution of quinine anti-malarial tablets among students in Šahryār, Karaj, in 1934, and another letter in which an outbreak of malaria is reported in Šāhābād-e Ḡarb, Kermānšāh Province in western Iran in 1935 (Azizi and Bahadori, pp. 131-35). Between 1943 and 1946, the Ministry of Health initiated the Malaria Control Program in the four cities of Khoramabad, Sanaddaj, Isfahan, and Shiraz, exclusively (Azizi and Bahadori, pp. 131-35).

The total population of Iran was around 18 million based on the census of 1946, and the annual cases of malaria were estimated at five million (Raeisi et al., p. 1). In 1947, the first pilot program of DDT insecticide spraying was carried out in Iran, supported by the Near East Foundation and the United Nations (Rosa, 1960, p. 352). In due course, in 1949, malaria control measures were reinforced, and the Office for Malaria Campaign (Edāra-ye mobāreza bā mālāriā) was founded by the government. The main goals were to combat malaria and to train malaria control experts. For the first year of the program, 5,500,000 tumāns was earmarked to malaria control in the areas along the Caspian Sea in northern Iran, as well as the two southern cities of Bušehr and Bandar Abbas (*Nāma-ye māhāna-ye Dāneškada-ye Pezeški,* pp. 52-53). At that time, malaria was also prevalent in Harand, near the Bātlāq-e Gāvḵuni, the terminal basin of the Zāyandarud, in eastern Isfahan (Azizi and Bahadori, 2012, pp. 657-58).

In 1950, a national program of malaria control was initiated in accordance to the malaria preventive goals outlined in Iran's First Seven-Year Development Plan (Rosa, p. 352; *Report on the Seven Year Development Plan*, p. 57), and public health measures recommenced to control malaria, initially in the more infected areas, but eventually the program was expanded, and DDT insecticide spraying on a large scale led to a proficient malaria control effort in

approximately 15,432 villages all over the country (Palmquist and Aldridge, 1954, p. 976).

Malaria was among the main subjects fully discussed in Iran's first International Medical Congress with more than 200 participants, held in 1952 in Rāmsar (Aḥmadi, 1971, p. 481).

Another influential step in the anti-malarial campaign in Iran was the establishment in 1952 of the Institute of Malariology in collaboration with the Parasitology Department of the University of Tehran's Faculty of Medicine and the Ministry of Health (Edrisiān, p. 3). It was headed by Nāṣer Anṣāri (b. 1913; Figure 2), who was sent to Paris in 1930 to study parasitology (*Rāhnemā-ye Dāneškada-ye Pezeški*, pp. 16-7). The institute benefited from technical support provided by the WHO. It collected scientific data regarding malaria on a regular basis, and offered courses for executive managers who were involved in the malaria control program (*The Report of the Institute of Malariology,* pp. 1-8).

In 1952, Sāzmān-e Hamkāri-e Behdāšt (the Public Health Cooperative Organization) was established in collaboration with the U.S. Point Four Program; its main objective was the promotion of public health and the implementation of preventive health care measures (Faghih, pp. 100-104). The malaria control program was the main priority of the organization (Raeisi et al., 2013, pp. 326-33). Between 1952 and 1955, malaria outbreaks were investigated in 5,421 villages by the Institute of Malariology, and in total, 288,644 rural residents were examined. The institute also sent 15 teams of researchers mainly to Baluchestan, Kerman, Fars, Khuzestan, Isfahan, Kermanshah, Gilan and Azarbaijan provinces. The establishment of the Central Malaria Diagnostic Laboratory in Tehran with branches in Abadan, Khoramabad, Isfahan and Shiraz was a constructive effort for the microscopic detection of malaria parasites in the blood smears of suspected patients (*The Report of the Institute of Malariology*, pp. 1-8).

In 1953, the centralized malaria control program was abandoned in favor of the more effective, decentralized administration of the spraying of the insecticide DDT. Permanent malaria control units were established in the provinces, supported by a central office in Tehran (Palmquist and Aldridge, pp. 977-79). Subsequent to the spraying of DDT in villages, including houses, malaria prevalence showed a sharp decline. In 1957, resistance of the anopheles vectors of malaria to DDT was reported for the first time. The

following year, the government approved a program, recommended by the WHO, and Iran officially entered the world malaria eradication campaign (Zaim, 1992, pp. 392-93). The campaign continued until 1961, when it was again discontinued due to emergence of resistance in the Anopheles mosquitoes in southern Iran (*Nāma-ye Māhāna-ye Dāneškada-ye Pezeški*, pp. 52 -53). Between 1964 and 1965, indoor DDT spraying of 43,896 villages with a population of 878, 414 was carried out; however, in 702 villages with a total population of 298,497, resistant cases of malaria were reported. To circumvent the resistance, Malathion organophosphate insecticide was substituted for DDT in house spraying (*Sālnāma-ye Kešvar-e Irān*, p. 386).

In 1964, the name of the Institute of Malariology, which trained malarialogist physicians and technicians, was changed to the Public Health Research Institute, and the first malaria research station was established in Kazerun, in southern Iran. In 1965, the institute was expanded, and its name was changed once again to the Institute of Malariology and Parasitology; it finally became the Institute of Medical Parasitology and Tropical Health (*Sālnāma-ye Kešvar-e Irān*, p. 76). In 1968, in addition to Malathion, various other preventive measures were undertaken, such as oiling stagnant waters with petrol products and the introduction of larvivorous fish (*Nāma-ye Māhāna-ye Dāneškada-ye Pezeški*, pp. 52-53). In the 1960s, several postage stamps were issued to highlight the malaria campaign in Iran (Afšār, XIII, pp. 161-65; Figure 3).

By 1973, malaria was under control in most areas north of the Zagros mountain range, a major malaria zone in Iran, and the total number of malaria patients was estimated at 16,000. However, in the next two years, malarial infections reached epidemic proportions in some parts of southern Iran, particularly in Hormozgān, Sistan va Baluchestan, and Kerman provinces. Travel of infected patients to disease-free regions had caused some localized foci of malaria to reappear in northern Iran (*Nāma-ye māhāna-ye Dāneškada-ye Pezeški*, no. 7, pp. 52-53).

Current malaria situation in Iran. The malaria control program was highly successful, and malaria was finally eradicated in most parts of the country (Raeisi et al., pp. 326-33). In comparison to the early decades of the 20th century, considerable progress has been made in the control of malaria, and the annual occurrences of malaria in Iran have decreased significantly (Faghih, table III, pp. 100-104). Since 1988, malaria control activities, including case diagnosis and treatment, have been integrated into the basic health care

services (Hanafi-Bojd, et al., p. 85) According to a study published in 2007, the majority (90 percent) of the occurrences of malaria in Iran were confined to the three endemic regions of Hormozgan, Kerman, and Sistan va Baluchestan provinces (Moosa-Kazemi et al., 2007, pp. 43-51). Between 2000 and 2010, the number of malarial cases fell by 85 percent, from 12,294 to 1,847 cases (Fattahi Bafghi et al.,b 2015, p. 89). In 2014, 1,200 malaria cases were detected in Iran, of which 625 patients had traveled from neighboring malaria-stricken areas (Edrisiān, 2016, pp. 37-40). As evidenced by a survey on malaria distribution in Khuzestan province, between 2001 and 2014, most malaria patients were non-Iranian migrants or travelers. (Salmanzadeh, et al, p. 1) In 2015, the total reported cases of malaria in Iran decreased to 647, of which 359 patients were immigrants (Edrissian, 2016, pp. 37-40).

At present, malaria foci in Iran are almost entirely limited to rural areas (Izadi, 2016, p. 222). The WHO reports that malaria in Iran is in the pre-elimination stage (*World Malaria Report*, 2013, p. 227), and there is a national goal of elimination of malaria by 2025 (Raeisi et al., pp. 326-33). The most challenging problem for malaria elimination in Iran is its proximity to the endemic neighboring countries (Salmanzadeh et al., 2015, p. 1) of Afghanistan, which has the second highest malaria burden in the WHO Eastern-Mediterranean Region and the fourth largest malaria burden in the world outside Africa (Holakouie Naieni, 2012, pp. 7-13), as well as Pakistan to the east and Iraq to the west.

BIBLIOGRAPHY

Ahmad Reza Afshar, “A Brief Iranian Medical History Through Commemorative Postage Stamps,” *Archives of Iranian Medicine* 13/2, 2010, pp. 161-65.

Ašraf Aḥmadi, *Irān: Goḏašta o ḥāl*, Tehran, 1971, p. 481.

Abu Bakr Rabiʿ b. Aḥmad Aḵawayni Boḵāri, *Hedāyat al-motaʿallemin fi’l-ṭebb*, ed. Iraj Afšār, Maḥmud Omidsālār, and Nāder Moṭallebi Kāšāni, Tehran, 2008.

Steven C. Anderson, “Insects,” in *Encyclopedia Iranica* XIII, 2006, pp. 151-57;

https://www.iranicaonline.org/articles/insects.

Behramgore T. Anklesaria, *Pahlavi Vendidād*, Bombay, 1949.

[Avicenna] Abu ʿAli Ḥosayn Ebn Sinā, *Qānun fi'l-ṭebb* (Canon of medicine), Per. tr. ʿAbd-al-Raḥmān Šarafkandi Hajar, Book 4, Tehran, 1991, pp. 105-8.

Mohammad Hossein Azizi and Moslem Bahadori, "The Life and Career of Professor Parviz Dabiri (1921–2012)," *Archives of Iranian Medicine*, 15/10, 2012, pp. 657-58.

Idem, "Brief Historical Perspectives of Malaria in Iran," *Archives of Iranian Medicine* 16/2, 2013, pp. 131-35.

Ḡolām-Ḥosayn Edrisiān, "Mālāriā dar Irān: Goḏašta va ḥāl," *Māh-nāma-ye dāḵeli-ḵabari-e Farhangestān-e ʿolum-e pezaeški*, no. 21, 2016, pp. 37-40.

Idem, "Malaria in Iran: Past and Present Situation," *Iranian Journal of Parasitology* 1, 2006, pp. 1-14.

Mohammad Ali Faghih, "Behdāri," in *Encyclopedia Iranica* IV, 1990, pp. 100-104.

Ali Fattahi Bafghi et al., "Comparison of Hematological Aspects Among Children with Malaria and Healthy children," *Iranian Journal of Pediatric Hematology Oncology*, 5/2, 2015, pp. 89-92.

Fazli Beg Khuzani Esfahani, *A Chronicle of the Reign of Shah Abbas. Volume III of the Afzal al-tavarikh*, ed. Kioumars Ghereghlou and Charles Melville, Cambridge, 2015.

Willem Floor, *Public Health in Qajar Iran*, Washington, D.C., 2004, p. 14.

A. Gächter-Jalilzadeh, *Briefe aus Persien. Jacob E. Polaks medizinische Berichte*, Wien, 2013; Per. tr. Tarāneh Ārāmeš, as *Nāmahā va gozāreshā-ye Yakob Eduard Polak az Irān: 1852-1862*, Tehran, 2013.

John Gilmour, *Report on an Investigation into the Sanitary Conditions in Persia* (Undertaken on Behalf of the Health Committee of the League of Nations at the Request of the Persian Government), Geneva, League of Nations, 1925; tr. Dariuš Pirniā and Parviz Ḵ̆ānsāri, as *Gozāreš-e Edāra-ye Ṣeḥḥiya-ye Jāmeʿa-ye Melal*, Tehran, 1976.

Kourosh Holakouie Naieni, Hossein Malekafzali, Arash Rashidian et al., "Malaria Status in Economic Cooperation Countries; Achievement and Gaps toward United Nations Millennium Development Goals," *Iranian Journal of Public Health* 41/7, 2012 pp. 7-13.

Ahmad Ali Hanafi-Bojd, Hassan Vatandoost, Mohammad Ali Oshaghi et al., "Entomological and Epidemiological Attributes for Malaria Transmission and Implementation of Vector Control in Southern Iran," *Acta Tropica*, no. 121, 2012, pp. 85-92.

Mark Harrison, *Disease and the Modern World: 1500 to the Present Day*, Oxford, 2004.

Ernst Hempelmann and Kristine Krafts, "Bad Air, Amulets and Mosquitoes: 2,000 Years Of Changing Perspectives on Malaria," *Malaria Journal*, no. 12, 2013, p. 2.

Shahrokh Izadi, "The Effects of Electricity Network Development Besides Routine Malaria Control Measures in an Underdeveloped Region in the Pre-elimination Phase," *Malaria Journal* 1/2, 2016, p. 222.

Zayn-al-Din Esmāʿil Jorjāni, *Ḏaḵira-ye ḵᵛārazmšāhi*, ed., Moḥammad Reżā Moḥarreri, Tehran, 2005.

Abdolwahab Manouchehrian, Morteza Zaim, and Amir Masoud Emadi, "A Review of Malaria in Iran, 1975-1990," *Journal of the American Mosquito Control Association* 8, 1992, pp. 381-84.

Mirza Abu'l-Ḥassan Ḵān-e Doktor, *Maṭlaʿ al-ṭebb-e Nāṣeri*, Tehran, 1882.

Rudi Matthee, *Persia in Crisis: Safavid Decline and the Fall of Isfahan*, London, 2012; Per. tr. Ḥasan Afšār, as *Irān dar boḥrān: Zavāl-e Ṣafavia va soquṭ Eṣfahān*, Tehran, 2014.

Steven R. Meshnick and Mary J. Dobson, "The History of Antimalarial Drugs," in *Antimalarial Chemotherapy: Mechanisms of Action, Resistance, and New Directions in Drug Discovery*, ed. Philip. J. Rosenthal, New York, 2010, pp. 15-24.

Mojtabā Minovi, "Hedāyat al-motaʿallemin dar ṭebb," *Yaġmā* 3/12, 1950, pp. 497-510.

Sayed Hassan Moosa-Kazemi, Hassan Vatandoost, Ahmad Raeisi, and Kamran

Akbarzadeh, “Deltamethrin Impregnated Bed Nets in a Malaria Control Program in Chabahar, Southeast Baluchistan, I.R. Iran,” *Iranian Journal of Arthropod-Borne Diseases* 1, 2007, pp. 43-51.

Manṣur Moʿtabar, “Mālāriā,” in *Epidemiology va control bimārihā-ye šāyeʿ dar Irān* (Epidemiology and control of common diseases in Iran), ed. Fereydun ʿAzizi, Moḥsen Jānqorbāni, and Ḥosayn Ḥātami, 3rd ed., Tehran, 2010, pp. 646-51.

Maḥmud Najmābādi, *Tārik̲-e ṭebb dar Irān-e Bāstān* (History of medicine in ancient Iran) I, Tehran, 1992.

Idem, *Tārik̲-e ṭebb dar Irān pas az Eslām* II (History of medicine in Iran after Islam), Tehran, 1993.

Nāma-ye māhāna-ye Dāneškada-ye Pezeški (The monthly journal of Faculty of Medicine), no. 7, 1949, pp. 52-53.

Emile E. Palmquist and Fredrick F. Aldridge, “Malaria Control in Iran,” *Public Health Reports*, 69/10, 1954, pp. 976-81.

Maḥmud Puršālči, *Qazzāq: Reżā Šāh bar asās-e asnād-e vezārat-e omur-e k̲ārejā-ye Farānsa*, Tehran, 2005.

Ahmad Raeisi, Mohammad Mehdi Gouya, Abolhassan Nadim et al., “Determination of Malaria Epidemiological Status in Iran’s Malarious Areas as Baseline Information for Implementation of Malaria Elimination Program in Iran,” *Iranian Journal of Public Health* 42/3, 2013, pp. 326-33.

Rāhnemā-ye Dāneškada-ye Pezeški, Dārusāzi, Dandānpezeški va bimārstanhā va āmuzešhā-ye vābasta, University of Tehran, 1951.

Report on the Seven Year Development Plan for the Plan Organization of the Imperial Government of Iran, New York, 1949.

Franz W. Rosa, “Malaria and Opium Control in Iran,” *Public Health Reports* 75/4, 1960, p. 325.

Moḥammad Zakariā Rāzi, “Dāruhā-ye mofrada,” *al-Ḥāwi*, Per. tr. Soleymān Afšāripur, XXI, Tehran, 2005.

Moḥsen Rustāʾi *Tārik̲-e ṭebb o ṭebābat dar Irān: az ʿaḥd-e Qājār tā pāyān-e ʿaṣr-e*

Reżā Šāh, Tehran, 2003, II, pp. 30-33.

Esmāʿil Ṣāʿebi, "Mālāriā," *Bimārihā-ye protozoā-ʾi dar Irān* (Protozoal diseases in Iran) I, Tehran, 1998, pp. 237-50.

Mohammad M. Sajadi, Reza Bonabi, Mohammad Reza Sajadi, and Philip K. Mackowiak, "Akhawayni and the First Fever Curve," *Clinical Infectious Diseases* 55, 2012, pp. 976-80.

Shokrollah Salmanzadeh, Masoud Foroutan-Rad, Shahram Khademvatan et al., "Decline of Malaria Incidence in Southwest of Iran (2001–2014)," *Journal of Tropical Medicine*, 2015, pp. 1-6; available at https://www.ncbi.nlm.nih.gov/pubmed/26649056.

Sāl-nāma-ye Kešvar-e Irān (Sāl-e 21), *Mohemtarin eqdāmāt-e vezārat Behdāri az 6/11/1343 tā 10/10/1344* (The major services of the Ministry of Health from 1965 to 1965), Tehran, 1345 Š./1965, pp. 386, 66-76.

ʿAli b. Sahl Rabbān Ṭabari, *Ferdows al-ḥekma* (Paradise of wisdom), Per. tr. ʿAbd-al-Allāh Madani and ʿAbd-al-Hādi Brujerdi, I, Tehran, 2007, pp. 319-47.

The Report of the Institute of Malariology: On the Occasion of the World Health Day, 7 April 1956, Tehran, pp. 1-8.

Nicolas J. White and Joel G. Breman, "Malaria," in *Harrison's Infectious Diseases,* ed. Dennis L. Kasper and Anthony S. Fauci, New York, 2010.

World Health Organization, *World Malaria Report,* Geneva, 2013, p. 227.

Morteza Zaim, "Malaria Control in Iran, Present and Past," *Journal of the American Mosquito Control Association* 3/3, 1987, pp. 392-96.