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Original paper

Epidemiological features of malaria in Bushehr province, southwest of Iran

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ABSTRACT. The purpose of this research was to describe the malaria situation in Bushehr province from 2011 to 2018. The current study is a descriptive cross-sectional study based on available data. Between 2011 and 2018, 715 malaria patients were registered in the Bushehr province. The data were analyzed using IBM SPSS Statistics version 22. Male patients made up 92.7% of the total, while female patients made up 7.3%. The age group of 20–29 years had the highest frequency of malaria patients (42.3%), while the age group of over 50 years had the lowest frequency patients (2.5%). Regarding nationality, (96.9%) of malaria patients were Afghans, (2.2%) were Pakistanis, (0.8%) were Iranians, and (0.1%) were Indians. The disease was reported to be the most prevalent in 2017 and the least common in 2013 (29.6% and 2.6%). During this time, malaria prevalence has risen and fallen. Bushehr county had the greatest malaria prevalence (42%) and was followed by Kangan county (20.1%) and Asaluyeh county (12.9%). In terms of parasites, *Plasmodium vivax* was responsible for (94%) of the cases, *P. falciparum* for (2.4%), and mixed infection (*P. vivax* and *P. falciparum*) for (3.6%). Regarding disease transmission, (93.6%) was imported, (1%) was relapse, (0.4%) was indigenous, and (1.3%) was relapse and imported. Bushehr province is at risk of transmitting malaria due to suitable climatic conditions for the reproduction of vector mosquitoes. As well, it confronts the threat of imported malaria, which has caused concern in recent years as a result of the increase of job-seeking migrants. Strategies of malaria control, basic measures in the field of timely diagnosis and rapid and complete treatment of patients, especially in foreign nationals, vectors control, and preventive approaches are required to eliminate malaria in this province.

Keywords: Bushehr, Iran, malaria, epidemiology, prevalence

Introduction

Malaria is a life-threatening parasitic disease caused by *Plasmodium* parasites, which are transmitted to humans by mosquito bites from infected female *Anopheles*. *Plasmodium falciparum* and *Plasmodium vivax* species are the most dangerous human malaria parasites. Malaria is an acute febrile disorder. The first symptoms in a non-immune person are fever, headache, and chills. Malaria caused by *P. falciparum* can lead to serious disease and death. Severe malaria is often accompanied by severe anemia, respiratory discomfort caused by metabolic acidosis, or cerebral malaria. The parasite, the vector, the human host, and the environment all play a role in the intensity of transmission [1]. Malaria is currently a threat to around 40% of the world's population who reside in low-income countries. Despite the fact that the disease has existed in various parts of the world, it is today mostly found in tropical and subtropical countries, with poor African countries accounting for 90% of cases [2]. Malaria posed a threat to over half of the world's population in 2019. Sub-Saharan Africa accounts for the majority of cases and deaths. South-East Asia, the Eastern Mediterranean, the Western Pacific, and the Americas are all at risk, according to the WHO regions. In 2019, there were

Figure 1. Geographical location and map of Bushehr province in Iran

an estimated 229 million cases of malaria and 409 000 deaths due to malaria in 87 countries [3].

Despite the fact that progress in the global response to malaria has slowed, in recent years, there is an increasing number of countries with a low malaria burden. Algeria, Argentina, Armenia, Azerbaijan, Cabo Verde, China, Egypt, El Salvador, Georgia, Islamic Republic of Iran, Iraq, Kazakhstan, Kyrgyzstan, Malaysia, Morocco, Oman, Paraguay, Sri Lanka, Syrian Arab Republic, Tajikistan, Turkey, Turkmenistan, Uzbekistan and the United Arab Emirates are among the 24 countries that have approached and achieved the goal of zero malaria transmission between 2000 and 2020. For the past three years, they have reported zero indigenous malaria cases [4].

According to historical records, malaria has been reported in the I.R. Iran for thousands of years. The disease was the most serious public health problem in the I.R. Iran in the early 20th century. Malaria had become the biggest cause of death in the country by the 1940s, with an estimated 5 million new cases per year. A national malaria elimination campaign, which began in 1956, was successful in reducing the country's malaria burden. Although malaria had become endemic in three in the southeastern provinces by 1990. The number of cases peaked at over 98 000 in 1991, then steadily dropped. The I.R. Iran established a goal of eliminating malaria by 2025 in 2010. These efforts resulted: in 2018, the I.R. Iran recorded its last indigenous case of malaria. Nevertheless, the continued relocation of migrant border workers is a continuous danger to this achievement. More than 80% of cases discovered in the I.R. Iran in recent years have been imported [5].

Bushehr province is regarded as a malaria at risk region in Iran due to climate variables like temperature and humidity, as well as the presence of important vector mosquitoes, gas economic projects that draw foreign migrants, and closeness with the country's southern regions.

The purpose of this study was to describe the situation of malaria in Bushehr province from 2011 to 2018. We expect that the information gained from this study will help policymakers and officials in the area make more informed decisions about malaria control.

Materials and Methods

Study area description

This research was conducted in Iran's Bushehr Province, which has a lengthy shoreline along the Persian Gulf (28.9184°N 50.8382°E). Bushehr is the province capital, whereas the other nine counties are Asaluyeh, Dashtestan, Dashti, Deyr, Deylam, Jam, Kangan, Ganaveh, and Tangestan (Fig. 1).

Data collection

Based on available data, the current study is a descriptive cross-sectional study. The research population includes all cases of malaria infection registered with the Bushehr State Health Department. Between 2011 and 2018, patients were

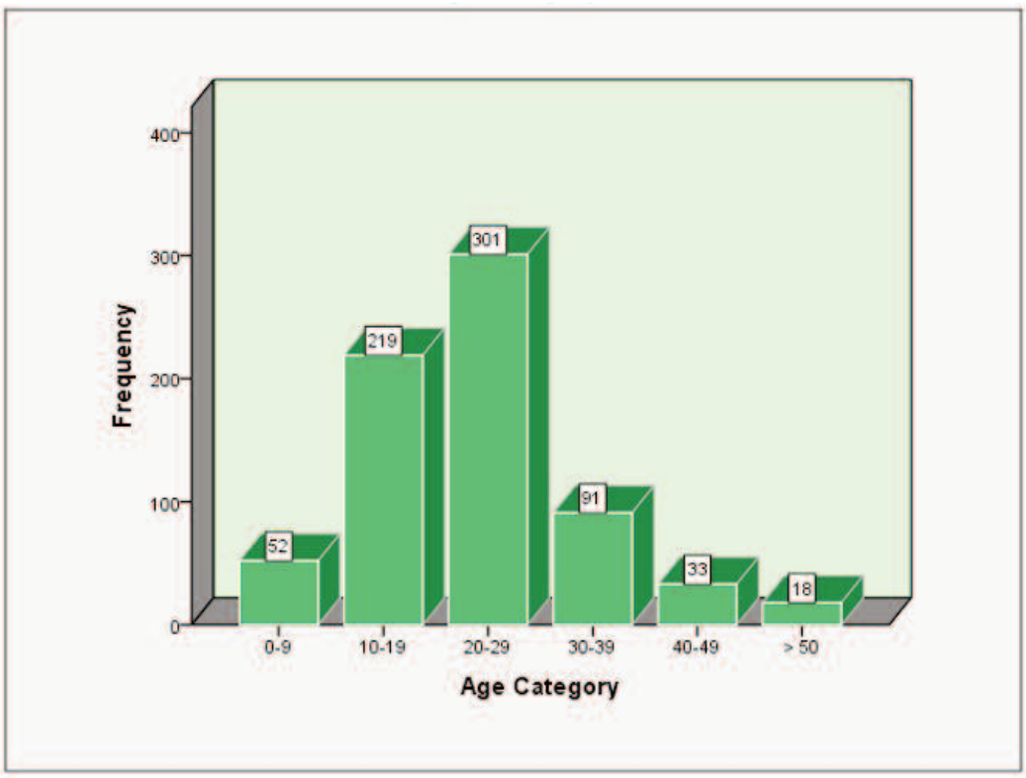

Figure 2. Distribution of malaria by age group

actively and passively identified. The criteria for detecting and recording positive cases of malaria is to test thin and thick areas of blood, stained by the Giemsa method with a magnification of ×1000 microscopically. All cases diagnosed throughout the province are registered and followed up in the Deputy of Health of Bushehr Province. The medical and health records of the patients are stored in the archives of the Bushehr State Health Department's Infectious Diseases Prevention Unit. Patients' data were collected through the checklist from the archives of the Infectious Diseases Prevention Unit

Table 1. Distribution of malaria in Bushehr Province according to age categories of patients

Age	0–9	10–19	20–29	30–39	40–49	>50
County	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Asaluyeh	13 (25.0)	34 (15.1)	27 (9.0)	11 (12.2)	2 (6.1)	5 (27.8)
Bushehr	3 (5.8)	84 (38.5)	140 (46.5	43 (47.8)	22 (66.7)	8 (44.4)
Dashtestan	9 (17.3)	36 (16.5)	27 (9.0)	6 (6.7)	1 (3.0)	0 (0.0)
Dashti	1 (1.9)	6 (2.8)	13 (4.3)	2 (2.2)	1 (3.0)	0 (0.0)
Dayer	5 (9.6)	5 (2.3)	10 (3.3)	4 (4.4)	1 (3.0)	1 (5.6)
Genaveh	0 (0.0)	2 (0.9)	6 (2.0)	1 (1.1)	0 (0.0)	0 (0.0)
Jam	11 (21.2)	6 (2.8)	16 (5.3)	5 (5.6)	0 (0.0)	1 (5.6)
Kangan	10 (19.2)	45 (20.6)	61(20.3)	17 (18.9)	6 (18.2)	3 (16.7)
Tangestan	0 (0.0)	1 (0.5)	1 (0.3)	1 (1.1)	0 (0.0)	0 (0.0)
Total	52 (100.0)	219 (100.0)	301 (100.0)	91 (100.0)	33 (100.0)	18 (100.0)
	7.3%	30.6%	42.3%	12.6%	4.6%	2.5%

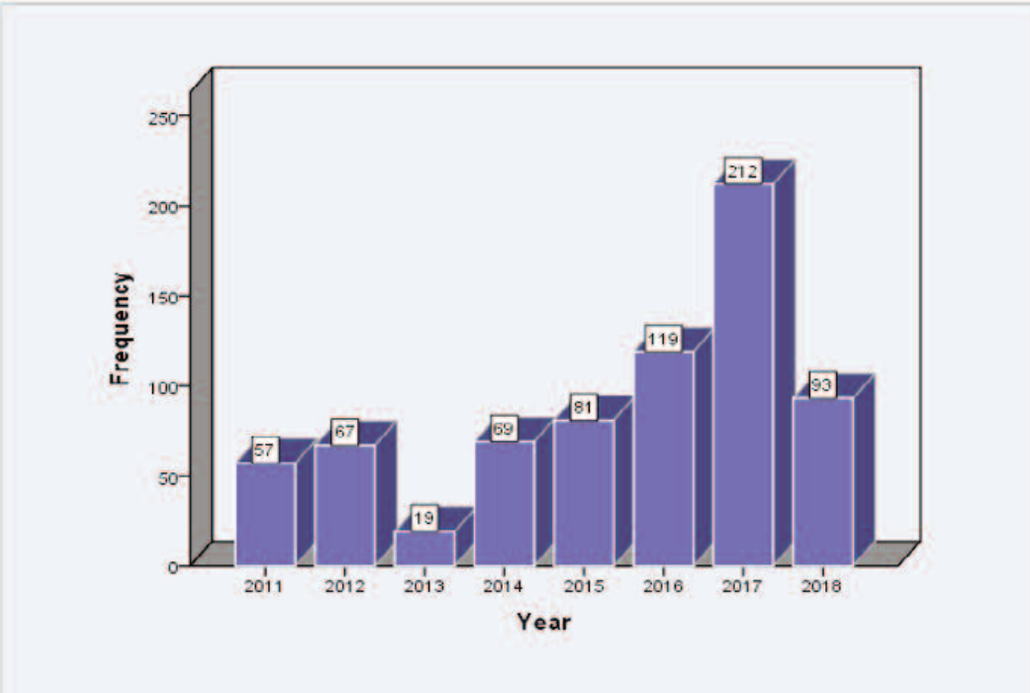

Figure 3. Distribution of malaria by year

of Bushehr State Health Department. Patients' demographic and epidemiological data, such as age, gender, nationality, residential area, month and year of infection, parasite type, and route of transmission, are included in the checklist.

Data analysis

Data were cleaned up and prepared for analysis by removing and modifying data that is irrelevant, incomplete or duplicated. IBM SPSS Statistics version 22 was used to analyze the data. The descriptive analysis in malaria used frequencies and percentages, means, and standard deviations. To determine the relationship between categorical variables, the Chi-square test was performed. The Fisher's exact test was used to examine the

Table 2. Distribution of malaria in Bushehr Province according to year (2011–2018)

Year	2011	2012	2013	2014	2015	2016	2017	2018
County	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Asaluyeh	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	8 (10.0)	24 (20.2)	50 (23.6)	10 (10.8)
Bushehr	36 (63.2)	45 (67.2)	9 (50.0)	52 (75.4)	49 (61.3)	25 (21.0)	53 (25.0)	31 (33.3)
Dashtestan	4 (7.0)	3 (4.5)	2 (11.1)	5 (7.2)	7 (8.8)	9 (7.6)	34 (16.0)	15 (16.1)
Dashti	0 (0.0)	1 (1.5)	0 (0.0)	1 (1.4)	2 (2.5)	7 (5.9)	7 (3.3)	5 (5.4)
Dayer	0 (0.0)	1 (1.5)	0 (0.0)	1 (1.4)	3 (3.8)	9 (7.6)	11 (5.2)	1 (1.1)
Genaveh	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (3.4)	2 (0.9)	3 (3.2)
Jam,	3 (5.3)	2 (3.0)	0 (0.0)	0 (0.0)	1 (1.3)	4 (3.4)	25 (11.8)	4 (4.3)
Kangan	14 (24.6)	14 (20.9)	7 (38.9)	10 (14.5)	10 (12.5)	37 (31.1)	29 (13.7)	23 (24.7)
Tangestan	0 (0.0)	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)	1 (1.1)
Total	57 (100.0)	67 (100.0)	19 (100.0)	69 (100.0)	81 (100.0)	119 (100.0)	212 (100.0)	93 (100.0)
	8.0%	9.4%	2.5%	9.7%	11.2%	16.6%	29.7%	13.0%

association among categorical variables since the study sample size and cell sizes were relatively small. The significance level was set at $P<0.05$.

Ethical approval

This research was approved by the Ethics Committee of Bushehr University of Medical Sciences (IR.BPUMS.REC.1398.34).

Results

Demographic characteristics of malaria cases

Between 2011 and 2018, 715 malaria patients were documented in the Bushehr province. The findings, based on the demographic features of malaria patients are as follows. The patients' ages ranged from one year to 61 years and the subjects' mean age was 22.73±9.94 years. The gender of 663 (92.7%) patients was male and 52 (7.3%) was female. Regarding the nationality, 693 (96.9%) of malaria patients were Afghan, 15 (2.2%) were Pakistani, 6 (0.8%) were Iranian, and 1 (0.1%) were Indian. The age group of 20–29 years had the highest frequency of malaria patients, with 301 (42.3%), while the age group of over 50 years had the lowest frequency, with 18 patients (2.5%) (Tab. 1, Fig. 2). In terms of the distribution of malaria cases by year, the maximum frequency of the disease was 212 cases (29.7%) in 2017 and the minimum number was 19 cases (2.6%) in 2013. (Tab. 2, Fig. 3). Bushehr county had the highest prevalence of malaria, with 300 cases (42%), while Genaveh and Tangestan counties had the lowest, with 9 cases (1.3%) and 3 cases (0.4%) respectively (Fig. 4).

Epidemiological characteristics of malaria cases

The findings, based on the disease features of malaria patients in Bushehr province are as follows. In terms of parasite, 673 cases (94%) were caused by *P. vivax*, 17 cases (2.4%) were caused by *P. falciparum*, and 26 cases (3.6%) were caused by mix infection (*P. vivax* and *P. falciparum*) (Fig. 5). Regarding the disease transmission, 671 cases (93.6%) were imported, 7 cases (1%) were relapse, 3 cases (0.4%) were indigenous, and 9 cases (1.3%) were relapse and imported.

Discussion

The current study looked at the 8-year trend of malaria cases from 2011 to 2018. The goal of this descriptive cross-sectional study was to determine the demographic and epidemiological characteristics

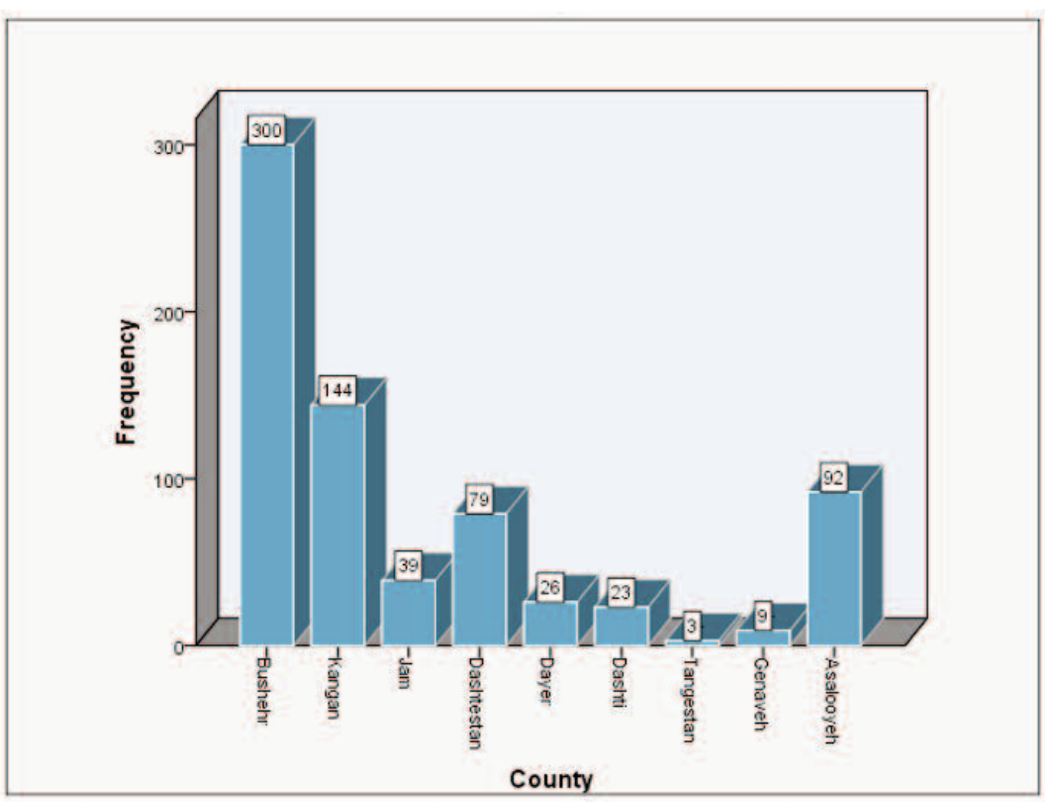

Figure 4. Distribution of malaria by county

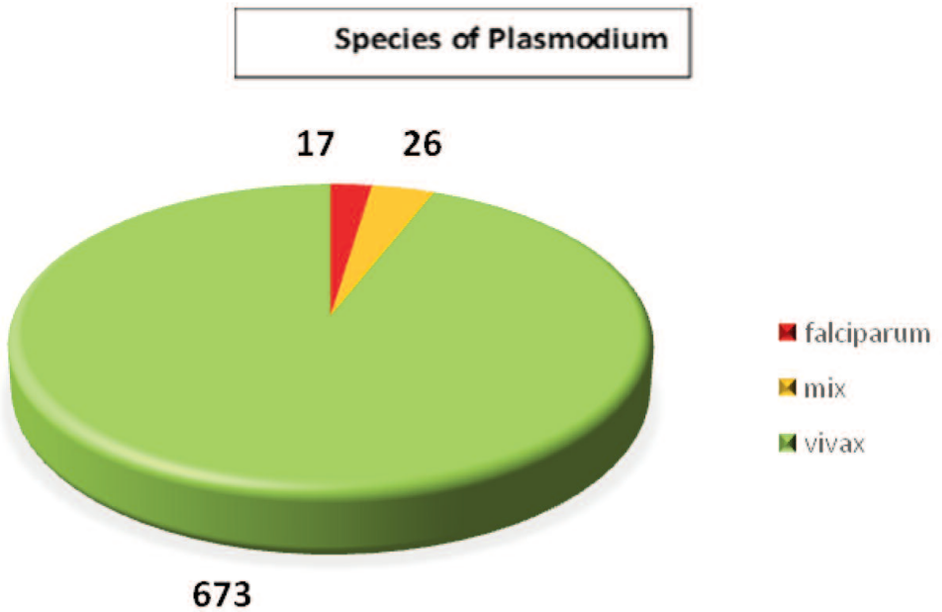

Figure 5. Distribution of malaria by species of *Plasmodium*

of malaria cases in Bushehr province as an endemic parasitic disease.

In this study, the mean age of patients was 22.73±9.94. Among the age groups, the highest frequency was related to the age group of 20–29 years with (42.3%), while the lowest frequency was related to the age group above 50 years with (2.5%). As well, the age group of 20–29 years in the research in Hamadan with (43%) [6], Bushehr with (36%) [7], Rafsanjan with (46.2%) [8], Larestan with (35.9%) [9] had the highest prevalence. On the other hand, in Hajiabad [10], Khozestan [11], Qom [12], the most cases of the disease occurred in the age group of 15 years and older with (62.8%), (84.65%), (67%), respectively. While, in Kohgiluyeh and Boyer-Ahmad [13] found that the age group under 20 with (63.3%) had the highest frequency of the disease.

The gender of malaria patients in the present study were 92.7% male and 7.3% female. Other epidemiological research on the prevalence of malaria in Iran revealed that in terms of gender, men were the majority of patients: In Hamadan (88.5%) [6], Kohgiluyeh and Boyer-Ahmad (64%) [13], Kohgiluyeh and Boyer-Ahmad (76.28%) [14], Mazandaran (88%) [15], Bushehr (97%) [7], Yazd (95%) [16], Rafsanjan (92.3%) [8], Bandar Abbas (64.5%) [17], Isfahan (93.5%) [18], Sarbaz (64%) [19], Konarak (77%) [20], Larestan (87.5%) [9], Hajiabad (53.5%) [10], Khozestan (92%) [11], East Azerbaijan (86.46%) [21], and Qom (64%) [12].

Regarding the nationality of malaria patients in this study, (96.9%), (2.2%) and (0.1%) belonged to Afghans, Pakistanis, and Indians, respectively and only (0.8%) of cases were Iranians. Epidemiologic studies in Mazanderan with (80.3%) [15], Yazd with (79.2%) [16], Rafsanjan with (98.9%) [8], Isfahan with (96.6%) [18], Kohgiluyeh and Boyer-Ahmad with (86.5%) [14], Larestan with (85%) [22], Khozestan with (84.85%) [11], Qom with (91.5%) [12], and south of Fars (95.7%) [23] confirmed that most malaria infections occurred in Afghan immigrants. On the other hand, the majority of malaria cases were Iranian in Kohgiluyeh and Boyer-Ahmad [13] (62.7%), Bushehr province (66%) [7], Bandar Abbas (79.3%) [17], Sarbaz (82.5%) [24], Konarak (78%) [20], Sistan and Balouchestan (77.3%) [25], Hajiabad (90%) [10].

In relation to the distribution of malaria based on the year in the present study, the highest and lowest frequency of disease was related to 2017 and 2013 with (29.6%) and (2.6%), respectively. While the number of malaria cases declined from 67 to 19 in 2013 compared to 2012, the rate of malaria increased from 69 to 212 between 2014 and 2017, and then decreased to 93 cases in 2018. Analysis of the pattern of malaria in recent years, in other epidemiological studies has shown a decrease in the disease incidence rate in Iran [10,11,21,22,26]. Although, the findings in a study of the south of Fars province revealed that the trend of malaria was ascending [23].

During the 8-year period (2011–2018), the incidence of malaria has increased from 2014 to

2017, which can be due to the increase in the number of foreign immigrants in the province and the intensification of activities to detect cases. In addition, between 2013 and 2018, there was a decline in the number of cases reported. The existence of a strong health and care system, the ability to quickly diagnose and treat patients, and fundamental steps to control the disease transmission cycle are all success elements in the fight against malaria and reducing the number of patients with it. The measures undertaken were: 1) malaria diagnosis involves obtaining blood (malaria smear) from suspects and examining it under a microscope, as well as the use of rapid diagnostic kits (RDTs), that cause early detection and treatment of patients, and as a result, parasitic reserves are destroyed and the transmission of the disease stops; 2) sampling of symptomatic migrants and those who have recently entered the province from malaria-prone areas (Afghanistan and some cities of Sistan and Baluchestan province); 3) drying wetlands or stagnant water by drainage, filling pits and covering the water source to reduce of habitat and reproduction of *Anopheles* mosquitoes; 4) controlling *Anopheles* larvae in stagnant waters using biological activities; 5) using of residual insecticides in homes to eliminate female *Anopheles* mosquitoes; 6) distribution of mosquito nets to avoid malaria vectors bites; 7) use of preventive antimalarial drugs for groups at risk such as seasonal workers on farms and workshops [27].

Regarding the distribution of malaria based on the county of residence in the Bushehr province during an eight-year period (2011–2018), the highest frequency of malaria was found in the Bushehr county (42%) followed by the counties of Kangan (20.1%) and Asaluyeh (12.9%). In contrast, the lowest frequency was found in Genaveh and Tangestan, with (3.1%) and (0.4%), respectively. Bushehr is the province's capital, Kangan and Asaluyeh are also important oil and gas production and export centers, and immigrants from other countries could find work in these places. This is consistent with the pattern of disease transmission, which is mainly imported malaria.

In terms of the type of parasite, *P. vivax* infection was observed in (94%) of cases, *P. falciparum* infection in (2.4%) of cases, and mixed infection in (3.6%) of cases in this study. Furthermore, previous malaria epidemiological research in Iran has found that *P. vivax* is the most common cause of disease. In the studies of Hamadan (91.1% and 7.7%) [6], Kohgiluyeh and Boyer-Ahmad (94.4% and 5.2%) [13], Kohgiluyeh and Boyer-Ahmad (91% and 8.3%) [14], Mazanderan (97%) [15], Bushehr (99% and 1%) [7], Bushehr (85% and 10%) [28], Yazd (85.2% and 13.7) [16], Bandar Abbas (97.69%) [17], Isfahan (94.6%) [18], Sarbaz (90% and 7.8%) [24], Konarak (91.5% and 1.2%) [20], Sistan and Balouchestan (88.6% and 9%) [25], Larestan (92.82% and 2.7%) [22], Hajiabad (99% and 1%) [10], Khozestan (88.35% and 11.65%) [11], East Azerbaijan (95.48% and 4.52%) [21], and Qom (91.31% and 7.34%) [12], south of Fars (85.8% and 4.2%) [23] and East Azerbaijan (83.7% and 14.81%) [26] have been reported for *P. vivax* and *P. falciparum*, respectively.

Regarding the route of transmission of the disease in the present study, showed that of the total cases of malaria, (97.2%) were imported malaria, (1%) relapse, (0.4%) indigenous and (1.3%) were relapse and imported. According to recent data, despite the declining trend in the prevalence of indigenous malaria in Iran, cases of imported malaria continue to occur. In Yazd [16] and Konarak [20] (80%) and (69%) of cases was imported, respectively. As well, imported and local transmission was found in Bushehr (70% and 11%) [28], Khozestan (93.9% and 6.10%) [11] and Qom (99.5% and 0.5%) [12]. While, in Hajiabad (94.2%) of cases were local, and (5.4%) imported [10]. In Larestan (50.16%), (44%) and (5.48%) of cases were imported, relapse and local, respectively [22].

In Iran, effective large-scale malaria control was established in the early 20th century, when malaria was the most serious public health problem. Spraying in the late 1940s resulted in significant reductions in the Caspian plains and Central plateau. Following that, in 1956, a national eradication program was launched, which was successful in significantly lowering malaria, especially in the southern regions. By 1980, the malaria program's goals had switched from eradication to control, which was accompanied by a widespread decline in the Zagros and southwestern plains and a concentration in the three southeastern provinces by 1990. By 2010, the program was again reoriented to national elimination. Malaria cases, which reached a high of 98,160 in 1991, steadily declined, with 92 reported in 2016. Importantly, no indigenous transmissions have been reported for the first time in 2018, but there is concern that imported cases may impede progress towards elimination [29].

Bushehr, in the southwest of Iran, has previously

been affected by malaria and is one of the places where local malaria transmission has occurred [30]. According to a report published by the Ministry of Health and Medical Education in 2018, 185 local cases of the disease were documented in 2005, with many of them occurring in agricultural areas. In 2015 and 2016, there were more imported and local cases than in 2013 and 2014. Bushehr has four active foci out of 262 active foci in 2015, and seven active foci out of 133 active foci in 2016. However, since 2016, no indigenous *P. vivax* or *P. falciparum* cases have been reported in Bushehr province [29]. Bushehr province is now confronting the threat of imported malaria, which has caused concern in recent years as a result of the increase of job-seeking migrants. In addition, favorable climatic conditions affecting the growth, amount and type of vector mosquitoes, in the transmission and spread of disease in this region. Preventive measures, timely and proper disease diagnosis and treatment, vector control programs, and the use of molecular tools to identify *Plasmodium* species must all be maintained up to date at all times.

In conclusion, during an 8-year period (2011–2018), it was discovered that while this disease had the lowest prevalence rate in 2013 (2.6%), it began to increase in 2014, and reached its highest prevalence rate in 2017 (29.7%). After that, in 2018, it was down to (13.0%). Economic opportunities for job seekers, the potential for the gas sector to attract foreign labor, the presence of agricultural and construction workers, as well as illegal refugees and migrants (mostly from Afghanistan), as well as environmental, climatic, sociological and cultural variables, all indicate Bushehr is one of the areas at risk of malaria. In the future, this circumstance may make malaria elimination and maintaining malaria-free status in Bushehr province challenging.

Acknowledgements

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References

[1] Home/Newsroom/Fact sheets/Detail/Malaria. 2021. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/malaria.

[2] Soofi K., Khanjani N., Kamiabi F. 2019. The challenges of the malaria elimination program in the South East of Iran: a qualitative study. *Journal of Arthropod-Borne Diseases* 13(1): 94–103.

[3] Home/Health topics/Malaria. 2021. World Health Organization. https://www.who.int/health-topics/malaria #tab=tab_1.

[4] Home News World Malaria Day. 2021. World Health Organization. https://www.paho.org/en/news/21-4-2021-world-malaria-day-who-launches-effort-stamp-outmalaria-25-more-countries-2025.

[5] Zeroing in on malaria elimination: final report of the E-2020 initiative. 2021. World Health Organization. https://www.who.int/publications/i/item/9789240024359

[6] Fallah M., Miraarab A., Jamalian F., Ghaderi A., Zolfaghari A. 2003. Epidemiology of malaria in Hamadan province during a 20-year period (1980–2001). *Journal of Kermanshah University of Medical Sciences* 7(2): 36–44.

[7] Darabi H., Raeisi A., Zare S., Pakbaz F., Kamran M. 2006. Epidemiological study of malaria in Bushehr province in 2005 *Journal of Kerman University of Medical Science* 13(2): 76–76.

[8] Zia Sheikholeslami N., Rezaeian M. 2010. The retrospective epidemiological study of malaria in Rafsanjan, Kerman province, from 1999 to 2005. *Journal of Health* 1(1): 24–30.

[9] Dehghan A., Hashemi B., Aliakbarpoor M., Moosazadeh M., Safari K., Hashemi Chalicheh M. 2015. Epidemiology study of malaria in Larestan during 2001–2011.*Hormozgan Medical Journal* 19(5): 373–379.

[10] Purrastgu-Haghi F., Dehghani S., Dosti S., Iranmanesh V., Qasemi A. 2015. The trend of malaria in Hajiabad County, Hormozgan Province, 2001–2014. *Journal of Preventive Medicine* 2(4): 71–77.

[11] Salmanzadeh S., Foroutan-Rad M., Khademvatan S., Moogahi S., Bigdeli S. 2015. Significant decline of malaria incidence in southwest of Iran (2001–2014). *Journal of Tropical Medicine* 2015: 138–143. doi:10.1155/2015/523767

[12] Saghafipour A., Jesri N., Noroozi M. 2016. The epidemiologic status of malaria in Qom province, during 2001–2012. *Tolooebehdasht* 16(1): 110–117.

[13] Moshfe A., Abou Alghasem H.S., Karimi Z. 2003. Demographic pattern of malaria in Kohgiloyeh and Boyerahmad Province 1996–2003. *Armaghan Danesh* 8(31): 38–48.

[14] Manouchehri N.K., Arefkhah N., Mortezaei S.,

Hossani S., Nosrati V., Falahizadeh S., Dehghani F. 2014. Malaria situation in Kohgiloye and Boyerahmad Province during 2001–2010. *Armaghan Danesh* 18(9): 768–776.

[15] Najafi N., Ghasemian R., Farahmand M. 2006. Epidemiology of malaria in Mazandaran Province during 1999–2003. *Journal of Mazandaran University of Medical Sciences* 15(50): 125–132.

[16] Khalili M.B., Anvari-Tafti M., Sadeh M. 2009. Epidemiological pattern of malarial disease in the province of Yazd, Iran (since 1986–2006). *World Journal of Medical Sciences* 4(1): 41–45.

[17] Hanafi-Bojd A., Vatandoost H., Philip E., Stepanova E., Abdi A., Safari R., Mohseni G., Bruhi M., Peter A., Abdulrazag S. 2010. Malaria situation analysis and stratification in Bandar Abbas County, southern Iran, 2004–2008. *Iranian Journal of Arthropod-Borne Diseases* 4(1): 31–41.

[18] Soleimanifard S., Akbari M., Sabetghadam M., Saberi S. 2011. Malaria situation in Isfahan in the Last Five Years. *Journal of Isfahan Medical School* 29(132): 273–280.

[19] Reza Y.M., Taghi R.M. 2011. Prevalence of malaria infection in Sarbaz, Sistan and Bluchistan province. *Asian Pacific Journal of Tropical Biomedicine* 1(6): 491–492. doi:10.1016/S2221-1691(11)60107-X

[20] Jadgal K.M., Zareban I., Alizadeh S.H., Sepehrvand N. 2014. The epidemiological features of malaria in Konarak, Iran (2007–2011). *Journal of Torbat Heydariyeh University of Medical Sciences* 2(1): 54–49.

[21] Sarafraz S., Mehrabani N.G., Mirzaei Y., Jafari R., Mehrabani R., Hayati V.R., Parsaei M., Fatollahzadeh M. 2016. Epidemiology of malaria in East Azerbaijan province, Iran, from 2001 to 2013. *Journal of Parasitic Diseases* 40(3): 813–817. doi:10.1007/s12639-014-0584-6

[22] Eskandari F., Salehfard O. 2015. Malaria in the Larestan city during 1998–2010. *Iranian Journal of Infectious Diseases and Tropical Medicine* 20(70): 43–47.

[23] Delam H., Shokrpour N., Nikbakht H.A., Hassanipour S., Safari K., Bazrafshan M.R. 2020. Changing patterns in epidemiology of malaria between 2006 and 2018 in the south of Fars Province, southern Iran: the fall and rise of malaria. *Annals of Global Health* 86(1): 1–7. doi:10.5334/aogh.2850

[24] Youssefi M., Rahimi M. 2011. Prevalence of malaria infection in Sarbaz, Sistan and Bluchistan province. *Asian Pacific Journal of Tropical Biomedicine* 1(6): 491–492. doi:10.1016/S2221-1691(11)60107-X

[25] Sargolzaie N., Salehi M., Kiani M., Sakeni M., Hassanzehi A. 2014. Malaria epidemiology in Sistan and Balouchestan province during April 2008–March 2011, Iran. *Zahedan Journal of Research in Medical Sciences* 16(4): 41–43.

[26] Azizi H., Davtalab-Esmaeili E., Farahbakhsh M., Zeinolabedini M., Mirzaei Y., Mirzapour M. 2020. Malaria situation in a clear area of Iran: an approach for the better understanding of the health service providers' readiness and challenges for malaria elimination in clear areas. *Malaria Journal* 19(1): 1–10. doi:10.1186/s12936-020-03188-7

[27] Bushehr University of Medical Sciences. Bushehr State Health Department/University News Portal. https://www.bpums.ac.ir/En/SiteSearch.asp x?query (in Persian)

[28] Darabi H., Raeisi A., Shemshad K., Pakbaz F., Khajeian A., Hanafi-Bojd A., Rafinejad J. 2012. Malaria in Bushehr Province (2001–2008), Southern Iran: an approach towards elimination. *Journal of Pure and Applied Microbiology* 6(2): 565–569.

[29] Schapira A., Zaim M., Raeisi A., Ranjbar M., Kolifarhood G., Nikpour F., Amlashi M., Faraji L. 2018. History of the successful struggle against malaria in the Islamic Republic of Iran. Tehran (THR): Ministry of Health and Medical Education – Center for Disease Control. 1st ed. Neekpey.

[30] Edrisian G. 2006. Malaria in Iran: past and present situation. *Iranian Journal of Parasitology* 1(1): 1–14.

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