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Assessment of the Epidemiology and Factors Associated with the Malaria among Children in Sistan and Baluchistan Province, South East of Iran (2013-2016)

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Abstract

Background

Malaria is one of tropical and semi-tropical and vector-borne parasitic diseases produced by the protozoan parasites of the genus and species Plasmodium. The aim of this study was to assess the epidemiology and the factors associated with the malaria in children in Sistan and Baluchistan province in 2013-2016.

Materials and Methods

This cross-sectional study was conducted between March 2013 to March 2016 on 247 child cases of malaria in Sistan and Baluchistan province. Descriptive statistics were used to describe demographic and clinical status of malaria in children. The Chi-square test and Fisher's exact test were used to identify factors affecting malaria in children using SPSS 18, software.

Results: Of 247 cases, 51.8% were boys, 70.9% were in rural areas and 64.4 % were Iranian. Plasmodium Vivax with 83.8 % of cases was the most common species of the plasmodium. The relationship between parasite species and treatment failure, illness severity and type of treatment were statistically significant as ($P<0.05$).

Conclusion

Children are at high risk for malaria in Sistan and Baluchestan province; therefore, it is necessary that the primary and second level of prevention programs be done with more emphasis; as a result, prevent the occurrence or at least reduce the number of disease cases.

Key Words: Children, Epidemiology, Iran, Malaria.

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1- INTRODUCTION

Malaria as a vector-borne parasitic diseases in tropical and semi-tropical regions produced by genus of parasitic protozoans and species of Plasmodium. This disease is considered as one of most important public health problem with great morbidity and mortality. Estimated incidence for infection with Plasmodium Falciparum in the African area in year 2000 was 214 million (1), and for other years was as follow; 365 million in 2002 (2), 226 million in 2004 (3), 261milion in 2007 (4) and 173 million in 2009 (5). Also, according to the WHO worldwide report in 2014, around 200 million cases of malaria are reported yearly(6). Malaria spread across 108 countries in the world, and makes a deep impact on the socio-economic status (SES) of the people who live in these countries (2, 3, 7). About 85% of malaria morbidity and 90% of malaria mortality have occurred in sub-Saharan Africa (3). In the conducted study in 2009 by Cibulskis and et al., totally, 225 million malaria cases were reported (5th–95th centiles were 146–315 million), out of them, 78%, 15% and 5% were reported from World Health Organization (WHO) African Region, WHO South-East Asia Region and the WHO Eastern Mediterranean Region respectively. In Africa region, estimated cases per 1000 population at risk were 214 (95% confidence interval [CI] 133–302), in the Eastern Mediterranean region were 23 (95% CI 17–34) and in the Southeast Asia region were 19 (95% CI 14–26).

Based on WHO report, worldwide malaria incidence rate reduced by 37% and mortality rate by 48 %between 2000 and 2015(6). Although the highest of investments and efforts for malaria elimination have been conducted in high-burden countries (8, 9), in region such as southern Africa(10, 11), Mesoamerica, central Asia(12), and the Asia-Pacific region(13, 14), remarkable accomplishments have been prepared in malaria –eliminating. So, during the last 5 years, more countries such as Morocco, Armenia, Turkmenistan and the United Arab Emirates have been certified as malaria free(6). Epidemiological studies showed that yearly in the world, range of 0.7 to2.7 million people died by malaria infection, that out of them, above 75 % occurred among African children (10). More deaths from malaria are due to infection with Plasmodium Falciparum (2). Iran is one of the foci of malaria in the world. In recent years, the incidence of the disease has fallen sharply (11-13). One of important part of Iran that involved with malaria is Sistan and Baluchestan Province. The epidemiological pattern of malaria in this province is similar to two countries of Afghanistan and Pakistan that are eastern neighbors of Iran. However, the number of imported malaria from these two countries to Sistan and Baluchestan Province are remarkable. In Pakistan in 2014, about 29 %of population lived in high transmission region, 69 lived in low transmissions and 2% lived in malaria free region. Reported confirmed cases were 275,149 and numbers of reported deaths were 56 cases. Also, in Afghanistan in 2014, about 27% of population lived in high transmission region, 49% in low transmission region and 24% in malaria free region. Reported confirmed cases were 61,362 and numbers of reported deaths were 32 cases(13).

However, malaria remains as a serious health problem in Iran, particularly in South and Southeastern of country, especially in Hormozgan, Sistan and Baluchistan, and Kerman provinces. Whole number of individuals at risk in these regions according to the National Census held in 2011 were 7051498 (Kerman = 2,938,988, Hormozgan = 1,578,183, Sistan and Baluchistan = 2,534,327) (14, 15). As a result, malaria is health priority in these areas (16). We

haven't specific information on demographic, clinical and laboratory characteristics of malaria in children in this area; therefore implementation research in this area is essential. Given that in recent years none study have conducted among children in Sistan and Baluchistan province as one of the foci of the malaria in Iran, the aim of this study was to assessment of the epidemiology and the factors associated with the malaria among children in Sistan and Baluchistan province during 2013 to 2016.

2- MATERIALS AND METHODS

2-1. Study Design and Population

In a cross-sectional study, all malaria cases in children under 7 years old in Sistan and Baluchistan province were recruited. The province located in South East of Iran, neighboring Pakistan and Afghanistan and its capital is Zahedan city. Sistan and Baluchestan is broadest province in Iran, with an area of 187,502 km². The population of Sistan and Baluchistan according to the National Census held in 2011 was 2,534,327 people. Sistan and Baluchestan province consist of 15 counties including Chabahar, Qasar-qand, Dalgan, Hirmand, Iranshahr, Khash, Konarak, Nikshahr, Saravan, Sarbaz, Soran, Zabol, Zaboli, Zahedan and Zehak. Sistan and Baluchistan includes two sections, Sistan in the North of the province and Baluchistan in the South of the province. Today, Sistan and Baluchistan province consider as one of the driest areas of Iran. The province has common borders with Pakistan (900km) and Afghanistan (300 km).

In this province, the maximum annual temperature is 51°C. The coldest and hottest county in the Sistan and Baluchestan province are mainly Zahedan and Iranshahr. Malaria disease has endemic form in this province **(Figure1).**

2-2. Methods

Malaria cases were detected by two methods of Microscopic Diagnosis and Serology:

2-2-1. Microscopic diagnosis

In this method as gold standard for laboratory confirmation of malaria, Malaria parasites is identified by examining under the microscope a drop of the patient's blood that spread out as a blood smear on a microscope slide. The specimen is stained with the Giemsa stain to give the parasites a distinctive appearance.

2-2-2. Serology

Serology detects antibodies against Malaria parasites, using either indirect immunofluorescence (IFA) or enzyme-linked immunosorbent assay (ELISA).

2-3. Eligibility criteria

All patients of equal or less than 7 years included in present study they were confirmed as malaria cases and during the past month have lived in the study area. The patients with no information about disease history; diagnosis and treatment in surveillance system were excluded from the study.

2-4. Ethical considerations

With masking information about name, surname and residency address, other information including gender, age, nationality, residency, history of disease, treatment failure, illness severity, type of treatment, epidemiologic classification, stage of Parasites, Plasmodium species and type of slide were identified.

2-5. Data analyses

In descriptive analysis step, distribution of background (gender, age, location and nationality), clinical and laboratory variables (plasmodium species, life stages of the parasite, symptoms, history of disease, history of treatment failure, disease severity, type of treatment and classification epidemiological) of patients

are shown with the number (%). In analytical step, we examined the relationship between Plasmodium species and demographic, clinical and laboratory variables using Fisher's exact test and Chi-square test. Data were analyzed using SPSS version 18 software. $P \leq 0.05$ was considered as significant level of the tests.

Fig.1: Location of Sistan and Baluchistan Province in Iran

3- RESULTS

Totally, 247 cases of positive smears of malaria were recorded during the study period. Among them, 128 (51.3%) and 119 (48.2%) were boys and girls respectively. Children aged under or equal 1 year and 3 years had highest and lowest frequency (**Table.1**).The mean (SD) of age of patients was 4.43 ± 1.79. 70.9% of children with malaria were rural residents. The largest number of the patients reported from Sarbaz County and the lowest number of Khash and Zabol County (**Figure.2).** 64.4 % of patients were Iranian nationality. In the active screening program 131 (53%) cases of patients have been identified while 116 (47%) cases were identified during the passive screening program. The largest numbers of disease incidence were in autumn and the lowest number in winter (**Figure.3**).

Plasmodium Vivax was the cause of disease in 207 (83.8%) of patients, Plasmodium Falciparum in 33(13.4%) of patients and mixed species in 7 (2.8%) of patients. Sarbaz, Saravan and Chabahar districts together have 72% of the total reported cases of Plasmodium falciparum in Sistan and Baluchistan area. In 169 (68.4%) of patients Plasmodium were at Trophozoites stage of the development cycle of the parasite, in 24 (9.7%) of patients were in the Gametocyte stage, in 11 (4.5%) of patients were in the Schizont and in 43(17.4%) of patients were in the Gametocyte and Trophozoite stage. Most patients had no history of disease. Also, 234 (94.7%) of patients received treatment in outpatient basis and 13(5.3%) of patients received inpatient medical services. All patients that reported in this study received appropriate medical treatment. All patients recovered and there was no case of death due to malaria (**Table.2**). The Chi-square test and Fisher's exact test were used to investigate the relationship between type of parasite and

demographic, clinical and laboratory characteristics of patients. Significant relationships were found between plasmodium falciparum and biological stage of the malaria parasite ($P \leq 0.001$), residency place ($P=0.021$), season ($P=0.021$), treatment failure ($P \leq 0.001$), severity of illness ($P \leq 0.001$) and type of treatment ($P \leq 0.001$). In other words, most infection by plasmodium falciparum occurred in stage of Trophozoite, in rural area, in autumn, without treatment failure and no complication and in outpatient forms of treatment. However, no significant relationship was observed between plasmodium falciparum and nationality ($P = 0.139$), gender ($P = 0.737$), age ($P = 0.228$) and travel to endemic areas ($P = 0.057$) among the children **(Table.3 and 4)**.

Table-1: Demographic characteristics of children with malaria

Variables		Number	Percent
Gender	Boy	128	51.8
	Girl	119	48.2
Age groups (year)	≤1	9	03.6
	2	29	11.7
	3	53	21.5
	4	32	13
	5	46	18.6
	6	34	13.8
	7	44	17.8
Residency	Urban	72	29.1
	Village	175	70.9
Nationality	Pakistanis	84	34
	Afghan	4	01.6
	Iranian	159	64.4

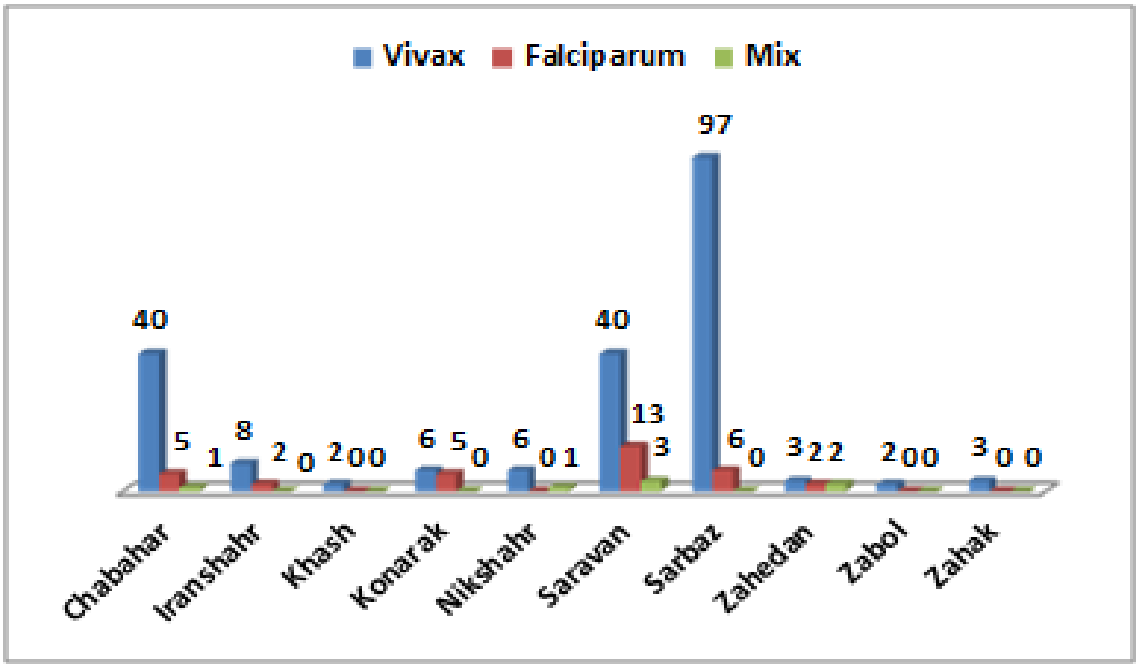

Fig. 2: The frequency of Plasmodium vivax, Falciparum and Mixed species in the counties of Sistan and Baluchestan Province, Iran (2013-2016)

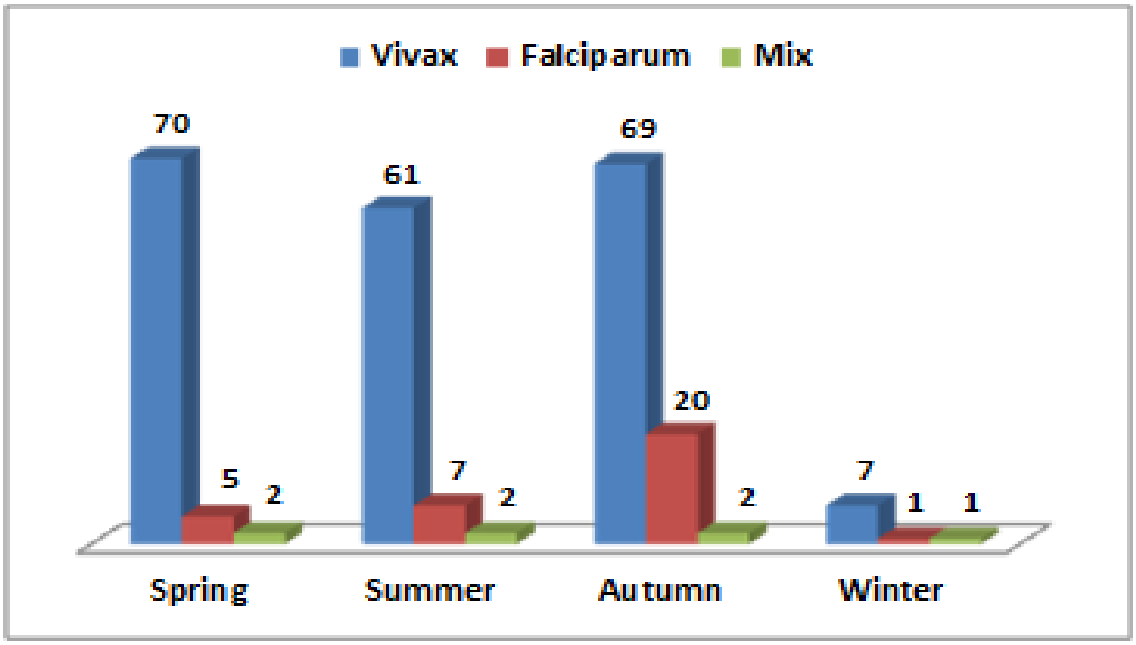

Fig.3: The frequency of Plasmodium Vivax, Falciparum and Mixed species according to season in Sistan and Baluchestan Province (2013-2016)

Table-2: Clinical and laboratory characteristics of children with malaria

Variables		Number	Percent
Type of slide	Fever suspected	217	87.9
	Other	30	12.1
Plasmodium species	Vivax	207	83.8
	Falciparum	33	13.4
	Mix	7	02.8
Stage of parasites	Trophozoite	169	68.4
	Schizont	11	04.5
	Gametocyte	24	09.7
	Gametocyte and Trophozoite	43	17.4
History of disease	Positive	5	02
	Negative	242	98
Treatment failure	Yes	4	01.6
	No	243	98.4
Illness severity	No complications	234	94.7
	Severe or complicated	13	05.3
Type of treatment	Outpatient	234	94.7
	Hospitalization	13	05.3
Epidemiologic classification	Local transfer	82	33.2
	Coming from the interior	16	06.5
	Imported from abroad	148	59.9
	The relapse	1	0.4

Table-3: Relationship between Plasmodium species and demographic, clinical and laboratory characteristics

Variables		Plasmodium Falciparum	Plasmodium Vivax or mix	P.value	Total
Gender	Boy	18(14.1)	110(85.9)	0.737	128(100)
	Girl	15(12.6)	104(87.4)		119(100)
Age (year)	1≤	2(22.2)	7(77.8)	0.228	9(100)
	2	7(24.1)	22(75.9)		29(100)
	3	4(07.5)	49(92.5)		53(100)
	4	5(15.6)	27(84.4)		32(100)
	5	3(06.5)	43(93.5)		46(100)
	6	5(14.7)	29(85.3)		34(100)
	7	7(15.9)	37(84.1)		44(100)
Nationality	Pakistanis	16(19)	68(81)	0.139	43(100)
	Afghan	0(0)	4(100)		4(100)
	Iranian	17(10.7)	142(89.3)		84(100)
Residency	Urban	4(05.6)	68(94.4)	0.021	72(100)
	Rural	29(16.6)	146(83.4)		175(100)
Season	Spring	5(06.5)	72(93.5)	0.023	77(100)
	Summer	7(10)	63(90)		70(100)
	Autumn	20(22)	71(78)		91(100)
	Winter	1(11.1)	8(88.9)		9(100)
Stage of parasites	Trophozoite	14(08.3)	155(91.7)	≤ 0.001	169(100)
	Schizont	3(27.3)	8(72.7)		11(100)
	Gametocyte	11(45.8)	13(54.2)		24(100)
	Gametocyte and Trophozoite	5(11.6)	38(88.4)		43(100)
Travel to endemic areas	Yes-in country(Iran)	3(20)	12(80)	0.057	15(100)
	Yes-Pakistan	23(17.3)	110(82.7)		133(100)
	No	7(07.1)	92(92.9)		99(100)

Table-4: Relationship between Plasmodium species and severity and treatment status

Variables		Plasmodium Falciparum	Plasmodium Vivax or mix	P.value	Total
Treatment failure	Yes	3(75)	1(25)	≤ 0.001	4(100)
	No	30(12.3)	213(87.7)		243(100)
Illness severity	No complications	25(10.7)	209(89.3)	≤ 0.001	234(100)
	Severe or Complicated	8(61.5)	5(38.5)		13(100)
Type of treatment	Outpatient	22(09.4)	212(90.6)	≤ 0.001	234(100)
	Hospitalization	11(84.6)	2(15.4)		13(100)

4- DISCUSSION

During the March 2013 to March 2016 in Sistan and Baluchistan province, 247 cases of malaria in 7- year- old children and younger were observed. Disease was more common among boys and rural residents and in Sarbaz County. Most cases occurred during autumn and the lowest in winter .Plasmodium Vivax was the most common type of Plasmodium species. Most patients had no history of the disease and received treatment on an outpatient basis.

Similar to other studies (17, 18), in Sistan and Baluchistan province malaria was more common in boys. Probably its cause was the amount of body covered by clothing, which in Iranian boys is less than girls. Also, compared to girls, boys are more likely to be present at night outside the home. Therefore, boys due to of higher exposure to vectors, have higher risk of malaria. At current study, approximately 70.9% of patients lived in rural areas. Similarly in the study conducted by Youssefi and Rahimi in Sarbaz County, that 91% of patients were lived in rural areas (18). These results suggest that the risk of malaria is higher in rural areas.

Similar to the other studies(19, 20), the most cases of malaria occurred during autumn and lowest in winter. Probably, the seasonal distributions of Anopheles mosquitoes are associated with seasonal difference in incidence of malaria. In autumn atmospheric rainfalls led to soil moisture and provide temporary water bodies on a small scale that have a key role in providing the right conditions for growth and reproduction of Anopheles mosquitoes. Thus led to increases in incidence of malaria in autumn. On the other hand, in winter reducing the temperature of the optimum threshold, led to increases in the number of days required to complete the external cycle of the parasite (20); therefore, the incidence of disease reduced.

In current study, more than 83% of cases were infected with Plasmodium Vivax, and Plasmodium Falciparum and mix contain 13.4% and 2.8% of cases, respectively. These results were parallel with other studies in the country (18, 21, 22). Also, in a study that conducted with Karim et al., in Pakistan (2011), Plasmodium Vivax was the cause of disease in 86.5% of cases (23). According to results of these studies, in this area Plasmodium Vivax was the first cause of malaria and Plasmodium falciparum was ranked second.

The highest number of malaria occurred in Sarbaz, Saravan and Chabahar, respectively. In other study that conducted with Salehi and et al., in Sistan and Baluchistan during 2005-2008, similar result observed. These counties have tropical climate, with a humidity and temperature reaching to optimal condition for malaria spread. Spatial modeling revealed that temperature, humidity and height were positively correlated with malaria risk (24). In total, 72% of annual reported cases of Plasmodium falciparum in Sistan and Baluchistan were from Sarbaz, Saravan and Chabahar districts. Moreover to the better ecological condition for transmission of the disease, these areas were in neighboring Afghanistan and Pakistan, two large foci of malaria in the world. That from which, entrance of malaria and especially Plasmodium falciparum maybe occurred. In our study, similar to other studies in Iran (18, 25), 35% of patients were imported malaria cases from Afghanistan and Pakistan. In many countries with malaria -eliminating programs, imported malaria cases are the exclusive or leading threat to success and preservation of elimination (26, 27). So, while in Sistan and Baluchistan majority of malaria patients were Iranian. But imported cases from Pakistan and Afghanistan to this province are important. These imported cases can lead to an increase in risk of

malaria transmission in Sistan and Baluchistan area. Similar to the other studies (28, 29) , the highest of treatment failure were observed in patients infected with Plasmodium Falciparum species. In recent years sensitivity of Plasmodium falciparum and vivax to chloroquine were reduced. The emergence and spread of drug resistance led to control, treatment and management programs of malaria faced with serious challenges(30). However, with the end of a decade of drought in the south of the country, increasing the population of the vectors and reduce the immunity of native inhabitants due to low transmission of disease, the risk of malaria epidemic in Sistan and Baluchistan area is not unexpected.

4-1. Limitations of the study

Current study had some limitations that should be considered; this study was conducted based on data from malaria surveillance system. So patients that for whom malaria detection checklist has been completed, reported and registered, consider in study. Therefore patients that their data is not registered, due to lack of access to them information's, are not considered in the study. In addition, this information has been collected for a goal other than research plan.

5. CONCLUSION

In current study, Malaria occurred more in children who were lived in rural areas of Sistan and Baluchestan. Plasmodium Vivax was the most important cause of disease. Chance of treatment failure was more in patients suffering from diseases caused by Plasmodium Falciparum. Most of the patients were observed in Sarbaz, Saravan and Chabahar County, respectively. All patients that reported in this study received appropriate medical treatment. All patients recovered and there was no case of death due to malaria. Due to the fact that malaria is endemic in Sistan and Baluchestan province, the children in this area are at high risk for disease. Therefore, it is necessary that the primary level of prevention programs, including health education, combating disease vectors and eliminate the disease parasite reservoirs, use of insecticides and mosquito nets done properly. Also, secondary level prevention programs such as diagnosis and appropriate treatment of patients should be done with more emphasis.

6- CONFLICT OF INTEREST

All the authors declare that they have no conflict of interest.

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