

Malaria in Different Regions in the Kingdom of Saudi Arabia during the Year 2018

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Abstract: The risk of acquisition of malaria in Saudi Arabia is limited to the Southwestern part of the country, with the highest number of cases reported from Gizan and Aseer regions. The Eastern Province of Saudi Arabia is free of local transmission of malaria since 1978. The lack of transmission of malaria in this province is related to the malaria control program that was set in place in 1948 (Al-Tawffiq, 2006). The present article searched Saudi Ministry of Health reports, data was obtained from Open Data Portal (https://data.gov.sa/Data/en/organizaton/ministry_of_health) is the data that can be freely used, re-used, and redistributed by anyone without any technical, financial or legal restriction. The collected data included notified malaria cases and malaria parasites species in twenty Regions which were: Riyadh, Makkah, Jeddah, Ta'if, Medinah, Eastern, Al-Ahsa, Hafr Al-Baten, Qaseem, Aseer, Bishah, Tabouk, Ha'il, Northern, Jazan, Najran, Al-Bahah, Al-Jouf, Qurayyat and Qunfudah. This article aimed to determine the malaria prevalence and species of Plasmodium causing the disease in different regions in the Kingdom of Saudi Arabia during the year 2018. Saudi Ministry of Health reported that malaria parasites were notified from 19 regions. Four malaria parasites species were reported: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale* and *Plasmodium malariae*. Out of 1015953 examined persons positive cases of malaria were found 2710, of which 1908 (0.19%) were a malignant malaria (*Plasmodium falciparum*), 802 (0.08%) were Benign Tertiary (*Plasmodium vivax* and *Plasmodium ovale*) and one case (0.00009%) were a Quartan (*Plasmodium malariae*). For *Plasmodium falciparum*, high number of cases were reported in Jazan (n = 1358), Jeddah (n = 118) and Eastern region (n = 101). For *Plasmodium vivax* and *Plasmodium ovale*, high number of cases were reported in Eastern (n = 208), Jazan (n = 158), Riyadh (n = 97) and Jeddah (n = 97). The prevalence of malaria in this study was found 0.27.

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1. Introduction

Malaria is endemic in 109 countries, spanning all continents, with the exception of Australia and Antarctica. Approximately 300 million people are affected by malaria resulting in the deaths of 1–1.5 million people every year (Sami *et al.*, 2017). About 3.2 billion people almost half of the world's populations are at risk of malaria (Khalifa *et al.*, 2017). Every year, 10.5 million cases and 49,000 deaths are reported in the Eastern Mediterranean region alone (Sami *et al.*, 2017). In the Kingdom of Saudi Arabia, malaria is known to exist and had been documented in pre-Islamic Arabic writings (Annobil *et al.*, 1994). Malaria endemicity is localized to the Southwestern part of the country, with the highest number of cases reported from Jazan and Aseer

regions (Al-Tawffiq, 2006; Alkhalife, 2003; Bashawri *et al.*, 2001). Malaria transmission still occurs in the north, western and especially endemic in lowlands of Aseer Region. Its existence is perpetuated there by continuous importation from Yemen. Besides there was a high threat of introducing malaria by pilgrims during Hajj and Umrah studies also indicate a risk of malaria transmission by blood transfusion (Jamjoom *et al.*, 2006). However there has been no local transmission in the Eastern Province since 1978 as a result of control programs that were initiated, as early as 1948 (Al-Tawffiq, 2006; Bashawri *et al.*, 2001). Saudi nationals' resident in Riyadh could also get exposed to malaria during visits to endemic areas or during travel to endemic areas within the Kingdom of Saudi Arabia (Alkhalife, 2003). Studies conducted

in 2001 and 2006 indicated that the eastern province of Saudi Arabia is free of indigenous malaria transmission (Sami *et al.*, 2017). In Al-Baha Province, although no malaria cases have been reported recently, the presence of competent mosquito vectors increase the potentiality of malaria transmission (Alahmed *et al.*, 2015), Saudi Ministry of Health reported in 2006 reported that 57.8% of local cases were in Jazan, 36.7% in Aseer, 3% in Al Medinah, and 1.2% for each of Makkah and Qunfudah. The highest percentage of cases recorded among foreigners was in Jazan (54.3%), followed by the Eastern region (13.5%) and Jeddah (6.4%). There is always a high risk of introducing malaria by pilgrims (Al-Harathi and Jamjoom, 2008). In 2009, out of 2333 reported malaria cases, only 58 (1.7%) were local cases, the rest were imported. In the Eastern Province, out of 700 malaria cases in year 2011, 99.1% were imported and only 0.9% was from Saudi citizens. Most local infections occur in the South-western regions of Jazan and Aseer, and the predominant species is *Plasmodium falciparum*. Imported cases came from the neighboring countries of Yemen and Sudan and the Indian subcontinent. Yemenites and Sudanese predominantly carry *Plasmodium falciparum*, while travellers from India and Pakistan are infected with *Plasmodium vivax* alone or in co-infection with *Plasmodium falciparum* (Nzila and Al-Zahrani, 2013). Recent findings indicate that *Plasmodium vivax* is also responsible for cerebral malaria, acute kidney injury, liver dysfunction, severe respiratory distress, abnormal bleeding, severe anaemia and multiple organ failure (Khan *et al.*, 2014). In 2013, the Saudi Ministry of Health reported 2513 cases nationally, most of which occurred in the Jazan region. The Jazan area is known for hyper endemic transmission of malaria due to continuous importation of cases from Yemen (Sami *et al.*, 2017). Mass blood surveys sampling 91,676 people across the Jazan region between 2012 and 2014, found only three infections (0.003%), all of which were imported from Yemen (Al Zahrani *et al.*, 2018). In 2015 report that out of 1,306,700 examined cases positive cases of malaria were 2620 (0.20%) , of which 1444 were a malignant malaria (*Plasmodium falciparum*), 1164 were a benign tertiary (*Plasmodium vivax* and *Plasmodium ovale*), 10 were a Quartan and 2 were a mixed (Khalifa *et al.*, 2017). Ministry of Health in 2016 in Kingdom Saudi Arabia found that of 1,267,933 examined cases positive cases of malaria were 5,382 (0.42%) , of which 3,922 were a malignant malaria (*Plasmodium falciparum*), 1,420 were a benign tertiary (*Plasmodium vivax* and *Plasmodium ovale*) and 40 were a Quartan (Al-Harathi and Jamjoom, 2008). *Plasmodium falciparum* is the predominant parasite strain causing malaria in Saudi Arabia and Yemen

(Sami *et al.*, 2017). Malaria is the one of the major health concerns, endemic in the lowland of Aseer region in the south western province and sporadic cases were reported in another region. Jazan region and the bordering of Yemen were classified as the most malarious parts in Saudi Arabia. Malaria was perpetuated there-by continuous importation, from Yemen (Nzila and Al-Zahrani, 2013). Malaria incidence in Saudi Arabia is relatively low and is represented along the South region of the Red Sea coast to the down border of Yemen where malaria is hyper endemic still have a high prevalence (Safia *et al.*, 2018; Sami *et al.*, 2017). The border spans 1326 km from the Red Sea to the border triangle with Oman. The most densely populated area is toward the Red Sea, including Jazan and Asir regions in Saudi Arabia, which share a 330 km land border with Yemen, and represent the last remaining foci of malaria transmission in Saudi Arabia. Conversely, malaria transmission in Yemeni Governorates that border Jazan and Asir remains persistently endemic despite some progress toward control prior to 2014 (Al Zahrani *et al.*, 2018).

In the Kingdom of Saudi Arabia, an extensive effort, started in the 1940s, has led to a substantial decrease of malaria cases in many parts of the country. In the Eastern and Northern provinces for instance, malaria has been eliminated since no local transmission has been observed for many years. Most cases are imported malaria, through emigrants who form the workforce in the country (Nzila and Al-Zahrani, 2013). In 1963, Saudi Arabia signed a pre-eradication program plan with the World Health Organization and started the destruction of reservoir of infection, public health education, large-scale vector control (by spraying residential houses with dichlorodiphenyltrichloroethane) in hyperendemic areas, weekly application of larvicides, ultra-low-volume space spraying, prompt treatment of malaria cases, and training of health workers on the control and management of malaria (Memish *et al.*, 2014).

The primary vector for malaria transmission is *Anopheles arabiensis* (Alshahrani *et al.*, 2016), prevalent mostly in the southwestern part of Saudi Arabia at altitudes below 2,000 meters. Secondary vectors include *A. sergentii*, *A. stephensi*, *A. superpictus*, and *A. multicolor* (World Health Organization, 2015). The following species of Anopheles mosquitoes recorded as primary malaria vector in Kingdom of Saudi Arabia: *A. gambiae* (Southern part), *A. sergentii* (Western region), *A. stephensi* (Eastern region) and *A. superpictus* (Northern region). In addition to the four mentioned species, the following Anopheles have been reported in the country: *A. cinereus* (Abha, Asir Regions), *A. dthali* (Western and Madinah region), *A. fluviatilis*

(Eastern Region), *A. multicolor* (Eastern, Western and Madinah Regions), *A. pharoensis* (Tabuk region), *A. pretoriensis* (Jazan Region), *A. pulcherrimus* (Eastern Region), *A. rhodesiensis* (Yanbu in Madinah Regions), *A. turkhudi* (Western and Madinah regions), *A. coustani* and *A. tenebrosus* (Eastern Region). None of these species have yet been incriminated in malaria transmission in Kingdom of Saudi Arabia. Previous studies only stated the importance of *A. gambiae* as a potential malaria vector in the Tihama. Also, recent studies revealed that *A. arabiensis* is the most important malaria vector in Jazan region (Waheed *et al.*, 2018) A total of 15 Anopheles species have been recorded, five of which are known to be competent malaria vectors: *A. arabiensis*, *A. sergentii*, *A. stephensi*, *A. superpictus* and *A. culicifacies*. *A. arabiensis* is currently the only known vector of malaria in Saudi Arabia (Michael *et al.*, 2014). The present article aimed to determine the malaria prevalence and species of Plasmodium causing the disease in different regions in the Kingdom of Saudi Arabia during the year 2018.

2. Material and Methods

The present article searched Saudi Ministry of Health reports, data was obtained from Open Data Portal (https://data.gov.sa/Data/en/organizatoin/ministry_of_health) is the data that can be freely used, re-used, and redistributed by anyone without any technical, financial or legal restriction. The collected data included notified malaria cases and malaria parasites species in twenty Regions which were: Riyadh, Makkah, Jeddah, Ta'if, Medinah, Eastern, Al-Ahsa, Hafr Al-Baten, Qaseem, Aseer, Bishah, Tabouk, Ha'il, Northern, Jazan, Najran, Al-Bahah, Al-Jouf, Qurayyat and Qunfudah. This article aimed to determine the malaria prevalence and species of Plasmodium causing the disease in different regions in the Kingdom of Saudi Arabia during the year 2018. Laboratory confirmation is obtained by demonstration

of malaria parasites in blood films (thick and thin film). This remains the gold standard method for the diagnosis, identification of Plasmodium species and estimation of parasite load (density). Parasite density is quantified by counting ≥ 200 WBC and expressed as number of parasites per 200 WBC or converted to number of parasites per microliter. Giemsa stain is recommended for identification of Plasmodium species and for parasite count. It used in all health facilities throughout the Kingdom (Malaria Elimination Program. National Malaria Drug Policy, 2018). Data were analyzed by Microsoft Office Excel, 2007.

3. Results

Ministry of Health in 2018 in Kingdom of Saudi Arabia found that of 1015953 examined persons positive cases of malaria were 2710, of which 1908 (0.19%) were a malignant malaria (*Plasmodium falciparum*), 802 (0.08%) were Benign Tertiary (*Plasmodium vivax* and *Plasmodium ovale*) and one case (0.00009%) were a Quartan (*Plasmodium malaria*). (Table 1) shows malaria parasites species and malaria prevalence. (Fig. 1) shows notified malaria cases by region in 2018, high number of malaria cases were reported from Jazan (n = 1516) and Eastern (n = 309). (Fig. 2) shows the occurrence of *Plasmodium falciparum*, high number of cases were notified in Jazan (n = 1358), Jeddah (n = 118) and Eastern (n = 101) regions. (Fig. 3) shows the occurrence of *Plasmodium vivax* and *Plasmodium ovale*, high number of cases were notified in Eastern (n = 208), Jazan (n = 158), Riyadh (n = 97) and Jeddah (n = 97). (Table 2) shows monthly notified malaria cases in endemic zones in 2018 the high number of cases from Jazan (n = 1516) and Jeddah (n = 215). (Table 3) showed the prevalence of malarial in different regions in Kingdom of Saudi Arabia study was conducted by Khalifa *et al.*, 2017.

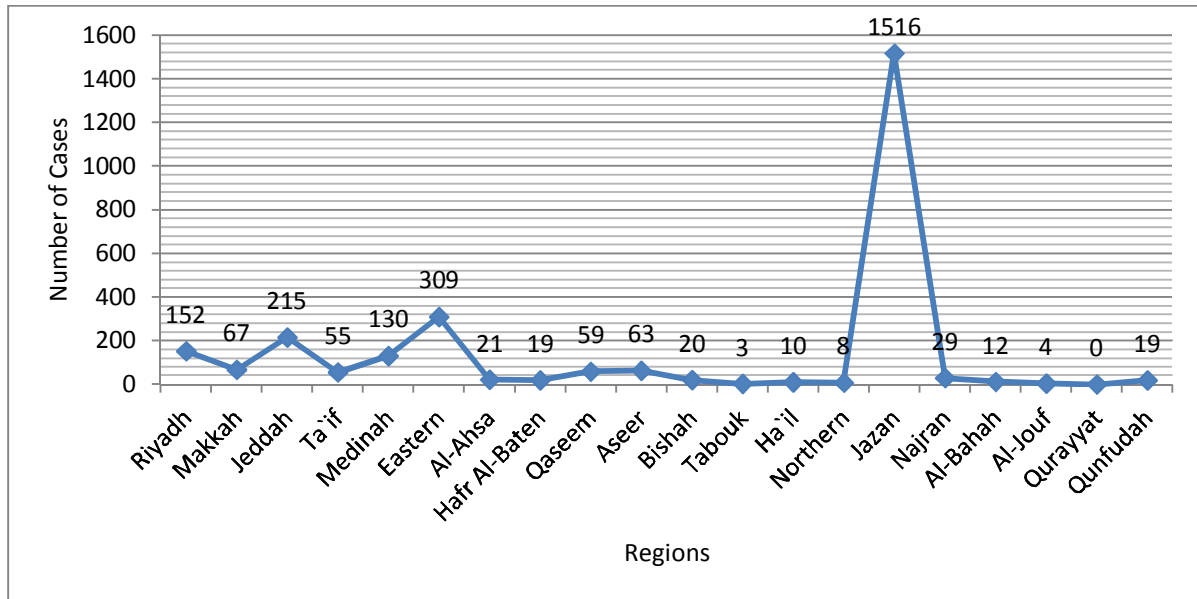


Figure 1. Notified Malaria Cases by Region of the Saudi Arabia, 2018

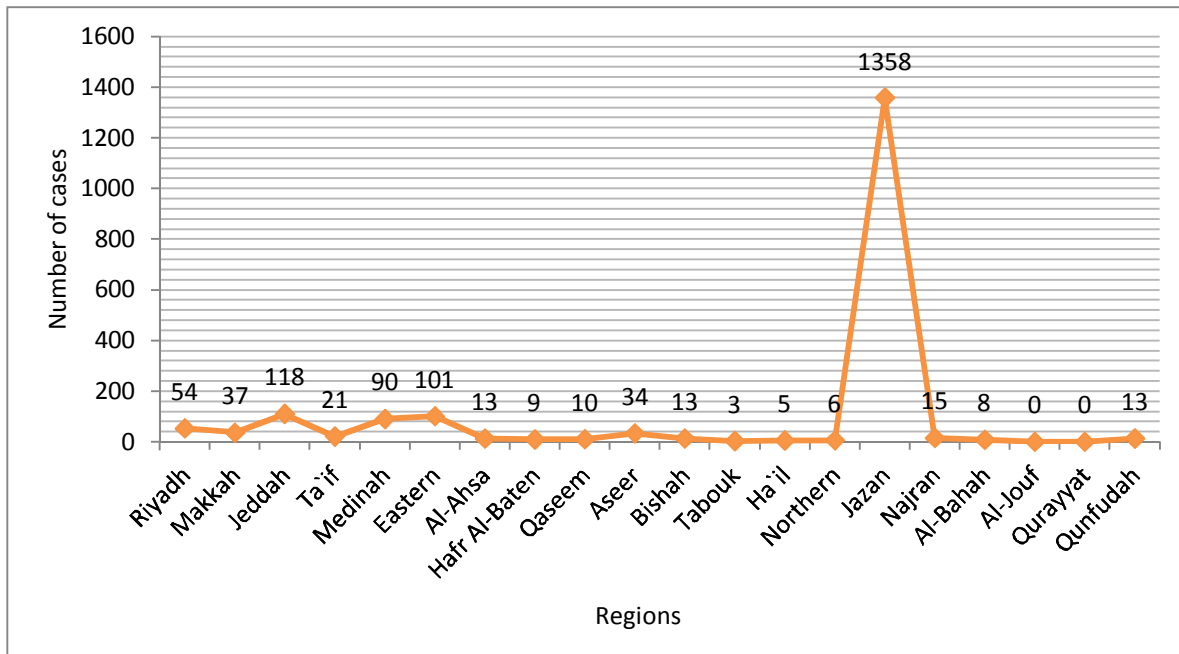


Figure 2. Occurrence of *Plasmodium falciparum* in Saudi Arabia, 2018

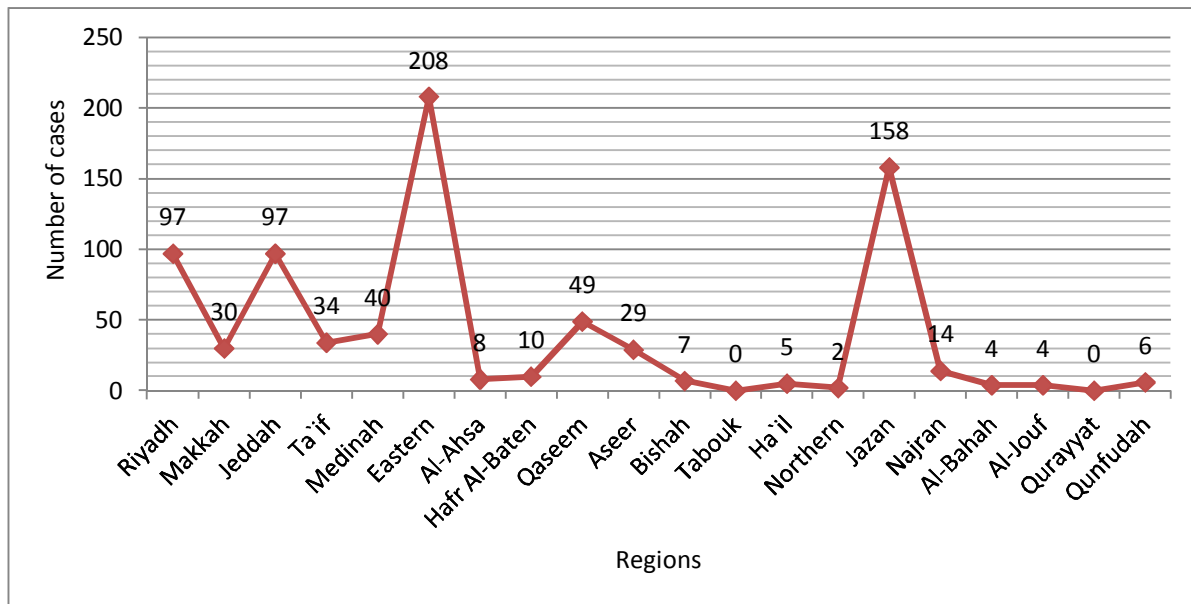
Figure 3. Occurrence of *Plasmodium vivax* and *Plasmodium ovale* in Saudi Arabia, 2018

Table 1. Prevalence of malaria by Regions of the Saudi Arabia, 2018

Regions	Number of examined persons	Number of positive cases			Prevalence
		<i>P. falciparum</i> (Malignant)	<i>P. vivax</i> and <i>P. ovale</i> (Benign Tertiary)	<i>P. malariae</i> (Benign Quartan)	
Riyadh	209823	54	97	1	0.072
Makkah	21386	37	30	0	0.31
Jeddah	6249	118	97	0	3.4
Ta'if	82897	21	34	0	0.066
Medinah	72347	90	40	0	0.18
Eastern	215322	101	208	0	0.14
Al-Ahsa	52203	13	8	0	0.04
Hafr Al-Baten	96	9	10	0	19
Qaseem	54398	10	49	0	0.11
Aseer	23322	34	29	0	0.27
Bishah	3357	13	7	0	0.59
Tabouk	9061	3	0	0	0.033
Ha'il	5767	5	5	0	0.17
Northern	1172	6	2	0	0.68
Jazan	184734	1358	158	0	0.82
Najran	22403	15	14	0	0.13
Al-Bahah	15804	8	4	0	0.075
Al-Jouf	26742	0	4	0	0.015
Qurayyat	7178	0	0	0	0
Qunfudah	1692	13	6	0	1.12
Total	1015953	1908	802	1	0.27

Table 2. Notified Malaria Cases in Endemic Zones, 2018

Region	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Makkah	1	4	2	6	3	0	7	28	6	6	2	3	67
Jeddah	19	15	11	11	11	6	8	16	23	36	37	22	215
Medinah	9	2	6	7	1	5	13	42	18	20	4	3	130
Aseer	3	5	4	1	5	4	11	2	0	11	11	6	63
Jazan	93	219	241	115	17	52	17	9	21	39	245	448	1516
Al-Bahah	0	2	0	0	0	0	0	1	2	5	1	1	12
Qunfudah	0	1	1	1	0	0	1	3	5	5	1	1	19
Total	125	248	265	141	37	67	57	101	74	122	301	484	2022

Table 3. The prevalence of malarial cases in different regions in Kingdom of Saudi Arabia

Years	examined cases	Malaria cases	Prevalence
2013	1,309,783	2513	0.19%
2014	1,249,752	2,305	0.18%
2015	1,306,700	2620	0.20%
2016	1,267,933	5,382	0.42%

Source, Khalifa *et al.*, 2017

4. Discussions

In the present article four malaria parasites species were notified: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale* and *Plasmodium malariae*. The major cause of malaria was found *Plasmodium falciparum*, Sami *et al.*, (2017) mentioned that the *Plasmodium falciparum* is the predominant parasite strain causing malaria in Saudi Arabia and Yemen. Khalifa *et al.*, (2007) reported that in year (2015) out of 1,306,700 examined cases positive cases of malaria were 2620 (0.20%), of which 1444 were a malignant malaria (*Plasmodium falciparum*), 1164 were a benign tertiary (*Plasmodium vivax* and *Plasmodium ovale*), 10 were a Quartan and 2 were a mixed (Khalifa *et al.*, 2017). Ministry of Health in (2016) in Kingdom Saudi Arabia found that of 1,267,933 examined cases positive cases of malaria were 5,382 (0.42%), of which 3,922 were a malignant malaria (*Plasmodium falciparum*), 1,420 were a benign tertiary (*Plasmodium vivax* and *Plasmodium ovale*) and 40 were a Quartan (Al-Harthy and Jamjoom, 2008). This article has shown that high numbers of cases infected with *Plasmodium falciparum* were notified from Jazan, Jeddah and Eastern region. Whereas for the *Plasmodium vivax* and *Plasmodium ovale*, the high number of cases were reported in Eastern region, Jazan, Riyadh and Jeddah these results agree with observations of previous studies conducted by Al-Tawfifiq (2006), Alkhalife (2003) and Bashawri *et al.*, (2001). In 2013, the Saudi Ministry of Health reported 2513 cases nationally,

most of which occurred in the Jazan region. The Jazan area is known for hyper endemic transmission of malaria due to continuous importation of cases from Yemen (Sami *et al.*, 2017). Al Zahrani *et al.*, (2018) indicated that mass blood surveys sampling 91,676 people across the Jazan region between 2012 and 2014, found only three infections (0.003%), all of which were imported from Yemen (Al Zahrani *et al.*, 2018). Jamjoom *et al.*, (2006) stated that malaria transmission still occurs in the north, western and especially endemic in lowlands of Aseer Region. Its existence is perpetuated there by continuous importation from Yemen. There was a high threat of introducing malaria by pilgrims during Hajj and Umrah. Observations of previous studies stated there was no local transmission in the Eastern Province since 1978 as a result of control programs that were initiated, as early as 1948 (Al-Tawfifiq, 2006; Bashawri *et al.*, 2001). The prevalence of malarial in different regions in Kingdom of Saudi Arabia in present article was found 0.27% it is low when compared with malaria prevalence in the year (2016), 0.42% study conducted by Khalifa *et al.*, (2017) and high than malaria prevalence in the year (2013) (0.19%), year (2014) (0.18%) and year (2015) (0.20%). Malaria incidence in Saudi Arabia is relatively low and is represented along the South region of the Red Sea coast to the down border of Yemen where malaria is hyper endemic still have a high prevalence (Safia *et al.*, 2018; Sami *et al.*, 2017). Limitations of this article include used of open access

data which contained information on notified malaria cases and regions which makes it difficult to determine any causative relationship. Nevertheless, this was a strategic approach to assess the baseline information regarding malaria prevalence and distribution.

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