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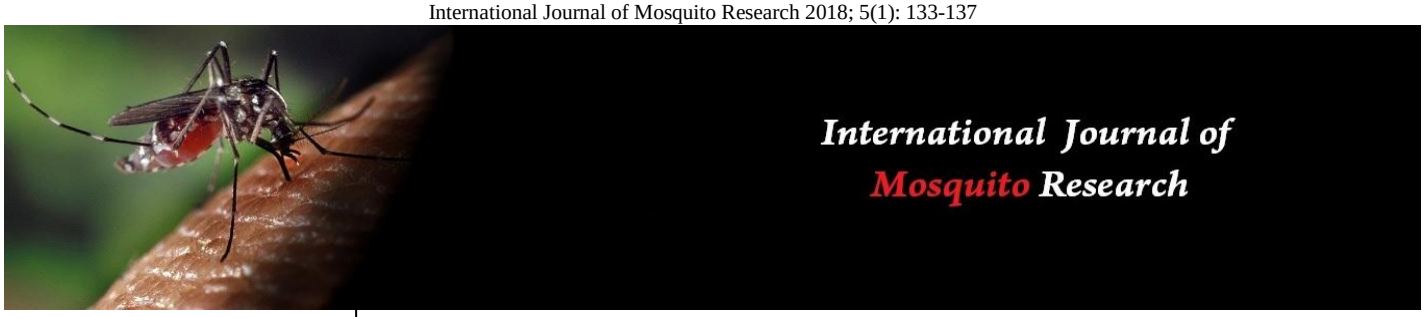

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The general inclination and global fund effects upon malaria incidence in Bashagard County, Iran

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Abstract
Malaria is ranked the major infectious diseases in Iran whose incidence has extremely declined in the recent years. Overall, 1407 patients were enrolled in Bashagard County during 2008-2017, south of Iran. Of them 772 (54.86%) were male and 635 (45.13%) were female. Malaria is distributed across all ages of patients. 559 (42.57%) of cases infected in the spring season. Remarkably, 82.4% of patients detected in 2008. More than 99% of cases scrimmaged against *Plasmodium vivax*. 1317 (93.6%) individuals confirmed by the microscopic method and 90 (6.39%) by rapid diagnostic tests (RDTs). It should be noted that 79.9% of the suspected case was detected through active surveillance. Approximately, 99% of malaria cases were autochthonous. Global Fund of Malaria positively affected malaria incidence through fortification of control programme financially. Notably, malaria case notification system (MCNS) should be improved into national surveillance of malaria.

Keywords: Autochthonous cases, Malaria, *Plasmodium vivax*, Bashagard, Iran

1. Introduction
Infective Anopheles mosquitoes are considered for transmission of malaria to human community. Blood transfusion, transplantation, and congenital transmission (during pregnancy) of malaria are lesser reported [1]. Indigenous malaria cases were reported from 91 endemic countries in 2016. Of them, 15 territories, in sub-Saharan Africa caused 80% of the global malaria mortality and 44 countries estimated fewer than 10,000 malaria cases [2]. Plasmodium falciparum, *P.* vivax, *P.* ovale and *P.* malaria are common protozoan agents that spread in many geographical areas [3]. Plasmodium falciparum is heavily extended in sub-Saharan Africa but this disease significantly reduced in many parts of Africa currently [4]. *Plasmodium vivax* serves as the major parasite rather than *P.* falciparum in which is the second pathogen of malaria in Iran as a Middle East country [5]. Notably, malaria flourishes in regions associated with favorable meteorological and environmental factors such as temperature, rainfall, and humidity [6]. Spatial analysis in framework of GIS (Geographical information systems) is worthy tool for mapping of high-risk regions with respect to environmental parameters. The outcome can help for management and control of malaria into undertaken interventions [7]. Combatting malaria programme began since 1951 in Iran [8]. A rapid resistance among mosquitoes to organochlorides (particularly DDT) was recorded in 1957 duo to intensive application of this group. Since then, using pesticides switched toward to Organophosphates with the different mode of action. Also, they substituted with carbamate over 1976-1991 [9]. At present, Iran is assigned to malaria elimination strategy. ITNs (insecticide-treated nets) and indoor residual spraying (IRS) with pyrethroids are appropriated approaches which implemented in south and southeast of this county [10]. Malaria is restricted to Sistan and Baluchistan, Hormozgan and Kerman provinces. Anopheles stephensi, An. culicifacies, An. dthali, An. fluviatilis, An. superpictus and An. pulcherimus are determinant vectors in this zone [11]. Bashagard county had always been one of the most hotspots of malaria in south of Iran. Moreover, it has species richness of Anopheles with respect to broad ecosystems and variation in seeking behavior. Hence, the degree of anthropophilic (preferring a human host for parasitism) and endophilic (mosquitoes tend to rest indoors) observed in Anopheline mosquitoes [12].

Bashagard was ranked first in Hormozgan province in term of indigenous malaria cases so that 74% of them were detected in this county [8]. The annual parasite incidence (API) was 0.08 at this region in 2009 [13]. Although the greatest decline in malaria incidence was documented in south of Iran, the imported cases from neighborhood countries are the complexity challenge into elimination phase [14]. This research sheds new light on the malaria aspects based on epidemiological and demographic variables of cases in Bashagard County south of Iran. We described all reasons and barriers relevant to malaria elimination logically. It is tracked the trends in malaria disease situation, therefore, our analysis can be used to continue all admirable efforts in this mission.

2. Materials and Methods

2.1 Study location

Bashagard county is located in the southeast of Hormozgan province in Iran with surface area of 9,200 km^2 (26°21′58″N 57°35′48″E) and population of 35,931 in 8,615 families at the 2017 census. Sardasht is the capital of Bashagard County. This domain is subdivided into three sectors so called the central district, Gowharan and Gafr moreover, has two cities: Sardasht and Gowharan. Notably, our study spot formed in 2008 by being split off from Jask County according to political division of Iran. Neighboring areas are Sirik, Jask, and Minab. In addition to, it lies between three provinces: Sistan and Baluchistan, Hormozgan and Kerman. Bashagard is enumerated as the poorest part of south of Iran. A Significant population of Bashagard moves to other scopes of Hormozgan province for working in building construction or industrial activities. The temperature remains high throughout spring and summer seasons, especially in July and August months. Its weather is hot and humid climate with low rainfall. Moderate climate is seen in mountain belt of this county.

2.2 Data source

As malaria infection is depending on many factors, we tried to gather the basic parameters for interpretation of malaria pattern in Bashagard district, Hormozgan province. We interviewed with medical practitioners and malaria experts of center for disease control and prevention (CDC) of Bashagard County. All essential information extracted from dossiers over 2008-20017 also they were entered into Excel software properly. This research was revised and survey by ethics committee of Hormozgan University of Medical Sciences (HUMS) eventually it was confirmed. The intelligence consists of 1407 malaria cases and relevant values such as age of patients, sex, habitat, occupation, nationality, type of agent parasites (vivax/falciparum), and administrative method for identification of parasitism, malaria surveillance, vogue, month and year of transmission. Our statics were perused by Chi-square test. P-value of ≤0.05 was given to determine the meaningful difference of results.

3. Results

Overall, 1407 patients were enrolled in our studies. Of them 772 (54.86%) were male and 635 (45.13%) were female. 99.6, 0.2, and 0.2% of malaria cases were Iranian, Afghanistani and Pakistani respectively (P=0.000). Notably, up to 99 % lived in rural and rest of them inhabited in urban areas (P=0.000). In term of occupation-except other jobs-students, housekeeper, worker, and farmer comprise 34, 12.7, 5 and 0.3% of positive cases (P=0.000). Malaria was distributed across all ages of our samples with higher level in 6-15 age group. The second group (≤5) consisted of 28.3% of all cases (P=0.000) (Table 1). It noteworthy that, no infected people were seen under <26 years old in 2017. Spring season was milestone period in term of transmission so that 559 (42.57) of them belonged to this interval. As such, the high level of prevalence occurred in June (P=0.000). (Figure 2). Surprisingly, 82.4% of patients indicated in 2008. In contrast, three years (i. e. 2013, 2014, and 2016) were free of inclusive infection (Figure 1). To comparison our view with other similar studies, we considered type of causing parasite of malaria. Hence, over 99% of cases scrimmaged against *P. vivax*. 1317 (93.6%) individuals identified by microscopic examination of blood smear and 90 (6.39%) by rapid diagnostic tests (RDTs). It should be noted that 79.9% of suspected case was detected through active surveillance and receive follow-up in according to national policy of malaria (P=0.26). We sorted the representative patients into four classes based on the mode of transmission i.e. local, imported, and relapsing and introduced cases. Our data was shown that the portion of local transmission was >99% (P=0.000) (Figure 3). All injured people were gratuitously treatment by anti-malaria drugs that provided by ministry of health and medical education (MOHME).

Table 1: Distribution status of malaria factors in Bashagard County

Epidemiologic parameters	Scale	Total (percent)
Sex	Male	772(54.86)
	Female	635(45.13)
Habitat	Rural	1397(99.28)
	Urban	10(0.71)
Occupation	Student	479(34)
	Housekeeper	179(12.7)
	Worker	70 (5)
	Farmer	4(0.3)
	Others	675(48)
Age group	≤5	398(28.3)
	6-15	462(32.8)
	16-25	230(16.3)
	26-35	98(7)
	>35	219(15.6)
Nationality	Iranian	140(99.6)
	Pakistani	3(0.2)
	Afghanistani	3(0.2)
Protozoan agent	P. vivax	1401(99.6)
	P. falciparum	6(0.4)
Diagnostic technic	Peripheral Blood Smear	1317(93.6)
	RDTs	90(6.39)
Malaria cases	Local	1402(99.64)
	Imported	2(0.14)
	Relapsing	1(0.074)
	Introduced	2(0.14)
Surveillance	Active	1124(79.9)
	Passive	283(20.1)

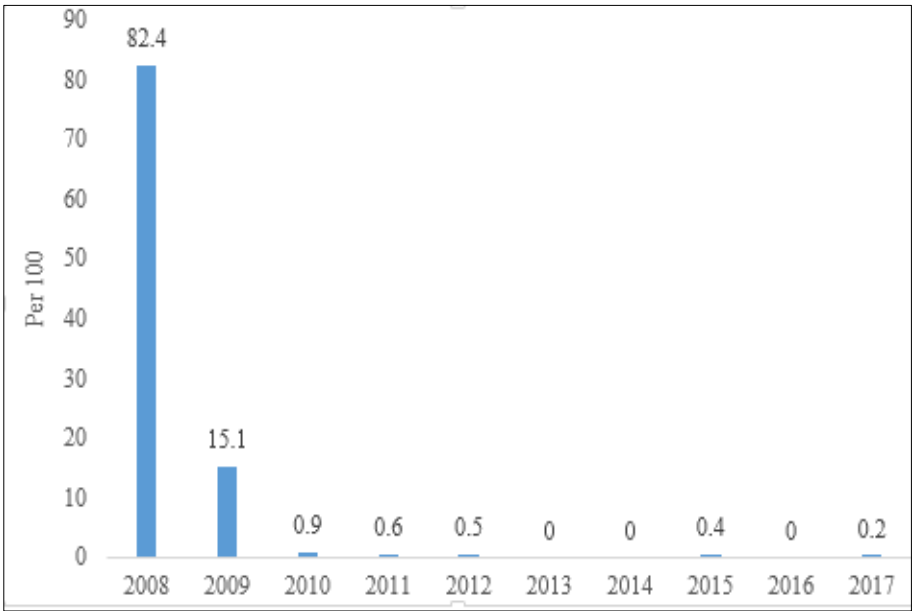


Fig 1: General outline of malaria cases over 2008-2017 years (no. 1407)

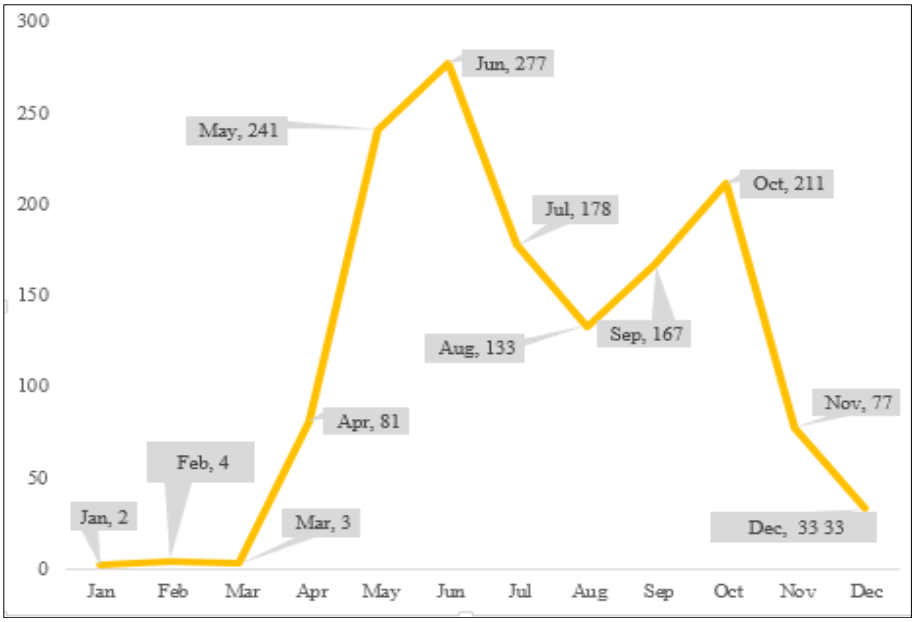
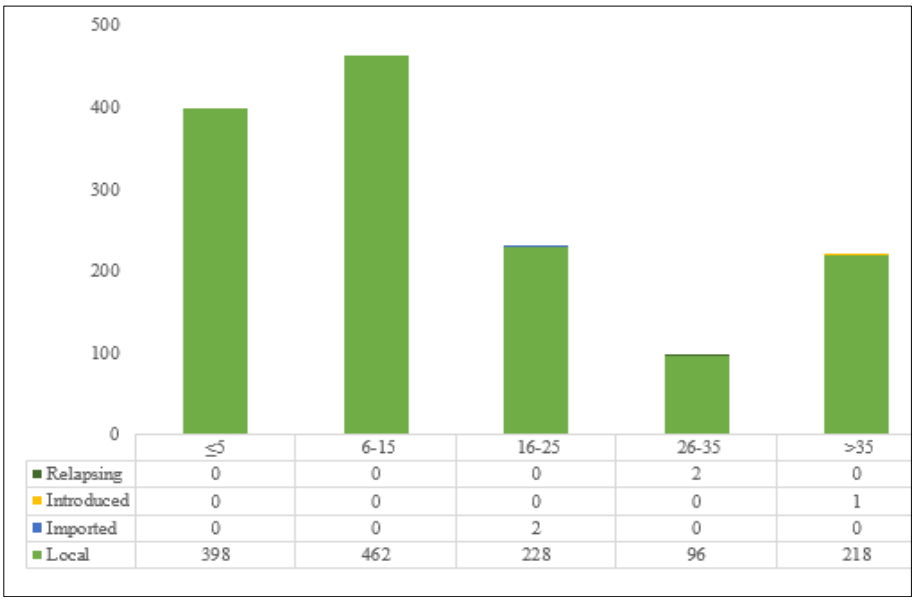


Fig 2: Contour of malaria infection based on month, Bashagard County

4. Discussion

At first glance, our view presented that prevalence rate of malaria has been extraordinary declined compared with past decade in Bashagard county. In the previous study, up to 16,000 patients have been reported during 1999-2009 [15] while, only 1,407 malaria cases recorded over 2008-2017 in our results. A series issues can describe the huge difference. We divided this profile into two sections with respect to global fund of malaria (pre-global fund (PrGF) and post global fund (PoGF). Bashagard district is accounted as the most deprived areas in south of Iran. In general, the settlements didn't access to electricity, piped water network and unpaved roads during PrGF (before 2008). All residents experienced poor health, low education and lack of facilities. Moreover, seasonal rivers provide desirable breeding places for Anopheles Mosquitoes in this county. In addition to, the traditional methods without standard criteria used for combat Anopheles larvae by health workers. For example, larvicidal petroleum oil was applied at incorrect recommended dosage in large quantities in unstudied areas. These larvicides can reduce the mosquitoes density particularly, related to late instar larvae and pupae. Golden Bear 1111® (Witco Corp, Oildale, CA) as a petroleum hydrocarbon successfully kills dipteran larvae over water surface in marsh, pond, ditch, standing water, and flooded waters. Nevertheless, it has a harmful effect on breathing of aquatic invertebrates and non-target organisms at abnormal concentrations due to their surface-active feature [16]. Indoor residual spraying (IRS) implemented irregularly. Most households had not bed-net due to destitution. The mass prophylaxis for malaria has been purposelessly administrated in risk areas of Bashagard before in PrGF course. Similarly, inferior access to health unit and delays in detection/treatment were problematic issues. On the other hand, there was shortage of professional manpower and laboratory for active detection in our study location. These factors, together slowed even obstructed the ongoing control of malaria. In 2008 (PoGF), the global fund to fight malaria contributed with national control system thereby, the setting

changed dramatically. Since 2002, a set of financing has been donated by this approach for evaluating and improvement of malaria elimination in endemic countries worldwide [17]. The global fund organized the control activities of malaria in south of Iran within training health providers, supporting required instrument (e. g. RDTs, ITNs, pump sprayer) and fortifying on-time reporting of malaria surveillance. Furthermore, the impetus of decision makers and civic agencies increased to centralize and establishment of public health services in PoGF. In this regard, the skilled persons recruited and employed in public health sectors through central government grant. The high-quality reference lab, health house, and clinics constructed in accordance with rural electrification and development of remote community access paved roads. Indeed, Long-lasting insecticide-treated nets (LLITNs) were widely delivered to the families and infected people. Apart from these strategies, Bacillus thuringiensis (BT) applied in conjunction with Temephos **(**trade name Abate**)** as the larvicides in control practices of mosquitoes in Bashagard County. Now, we argue other outcome concerning to the second part of our view. Nearly, malaria distributed in all age groups but 26-35 ages less embarrassed (Figure 3). This batch move to other adjacent regions with less endemicity for working within seasonal transmission of malaria whilst, the age of 5 years impressed with malaria in Africa countries frequently [18]. It is noticeable that rural blocks engaged extreme level of malaria prevalence (Table 1). The most population of Bashagard lived in villages. This spot has two urban places but these cities are without municipal facilities or city services. In fact, they characterized as the rural precinct in our database. June and October were two most involvement months from different seasons (Figure 2). The females of Anopheles stephensi, An. fluviatilis and An. dthali had more seasonal foraging response with respect to high anthropophilic rate in described months in Hormozgan province [19]. Autochthonous cases (local, introduced and relapsing) were the privileged classification of infected people (Figure 3). This scenario is opposite of elsewhere in Hormozgan province. For instance, 37.4% of malaria parasitism comprised of imported cases from neighborhood countries in Bandar Abbas district [20].



	≤5	6-15	16-25	26-35	>35
Relapsing	0	0	0	2	0
Introduced	0	0	0	0	1
Imported	0	0	2	0	0
Local	398	462	228	96	218

Fig 3: The mode of transmission of malaria into age group

As we stated above, our site is poorest areas in south of Iran. There aren't opportunities for job seekers and immigrants. Therefore, they are reluctant to stay in Bashagard for a long time. Plasmodium vivax was the majority of malaria parasite in our assessment places like other foci in south and southeast Iran [21]. Besides, no local transmission of falciparum has been observed since 2014 in Bashagard County. Giemsa microscopy technic principally performed for parasitological testing of disease. Also, RDT kits were additional method used over PoGF but it more focused on the laboratory test. RDTs were used in early 2008 for remote and isolated community without transportation link when there was a shortage of laboratory technicians and absence of electric. Kits also did not need specialist staff. However, antigen-based method kits are reliable procedure with high efficacy thereby, it can be used for identification of malaria parasites accurately [22]. After rural electrification, smear microscopy was largely applied to diagnosis in Bashagard because electricity provided power microscopy. Active surveillance was contemplated as the basic detection and follow up malaria cases in elimination phase. Health workers timely present at the targeted foci to survey the suspected cases, control interventions, and vector breeding places. A blood smear will be taken and delivered to the laboratory for examination if required [23].

5. Conclusion

It can be inferred that Iran is in a moderate transmission of malaria situation now. Substantially, eradication of malaria is possible if we adhere to the following doctrine:

1. Support the malaria elimination process constantly.
2. Malaria case notification system (MCNS) should be improved.
3. New potential foci will be subject to inspected.
4. Don't forget old active foci to prevent the reemerging of infection.
5. Entomological indices surveys are carried out coordinated with active surveillance accomplishment.
6. Strong patrol on the country border to prevent influx of illegal immigrants.

6. Acknowledgments We would like to express our deep gratitude to staffs and Health providers of center for disease control and prevention (CDC) of Bashagard County, for their contribution during registering malaria cases into Excel software.

7. Conflict of Interest: None declared.

8. References

1. Salmanzadeh Sh, Foroutan-Rad M, Khademvatan Sh, Moogahi S, Bigdeli Sh. Significant Decline of Malaria Incidence in Southwest of Iran (2001-2014). Journal of Tropical Medicine. 2015. Article ID 523767. http://dx.doi.org/10.1155/2015/523767.
2. World Health Organization. World malaria report, 2017. http://www.who.int/malaria/pu blications/world-malaria-report-2017/en/.
3. Rai PK, Nathawat MS, Onagh M. Application of Multiple Linear Regression Model through GIS and Remote Sensing for Malaria Mapping in Varanasi District, INDIA. Health Science Journal. 2012; 6(4):731-749.
4. Griffin JT, Hollingsworth TD, Okell LC, Churcher TS, White M, Hinsley W *et al*. Reducing Plasmodium falciparum Malaria Transmission in Africa: A Model-Based Evaluation of Intervention Strategies. PLoS Medicine. 2010; 7(8):100-0324. Doi:10.1371/journal.pmed.10003 24.
5. Hatam GR, Malaria. Control and Diagnosis. Iranian Red Crescent Medical Journal. 2010; 12(3):239-241.
6. Martin C, Curtis B, Fraser C, Sharp B. The use of a GIS-based malaria information system for malaria research and control in South Africa. Health and Place. 2002; 8:227-236.
7. Barati M, Keshavarz-valian H, Habibi-nokhandan M, Raeisi A, Faraji L, Salahi-moghaddam A. Spatial outline of malaria transmission in Iran. Asian Pacific Journal of Tropical Medicine, 2012, 789-795.
8. Raeisi A, Gouya MM, Nadim A, Ranjbar M, Hasanzehi A, Fallahnezhad M *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. 2013; 42(3):326-333.
9. Abaia MR, Mehravaran A, Vatandoost H, Oshaghi MA, Javadian E, Mashayekhi M *et al*. Comparative performance of imagicides on Anopheles stephensi, main malaria vector in a malarious area, southern Iran. Journal of Arthropod-Borne Diseases. 2008; 45:307-312.
10. Khosravani M, Rafatpanah A, Amiri SA, Zare A. The Field Practices of Lambdacyhalothrin and Deltamethrin Insecticides against Adult Mosquitoes of Anopheles stephensi as the Main Vector of Malaria Residual Effects. Zahedan Journal of Research in Medical Science. 2017; 19(4):7629. doi: 10.5812/zjrms.7629.
11. Soleimani-Ahmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR *et al*. Vector ecology and susceptibility in a malaria endemic focus in southern Islamic Republic of Iran. Eastern Mediterranean Health Journal (EMHJ). 2012; 18(10):1034-1041.
12. Azizi K, Poudat A, Soltani A, Mehranzadeh M. Fauna and some biologic charactristics of Anopheles mosquitoes (Diptera: Culicidae) in malaria high risk regions: Hormozgan Province, 2007-2008. Journal of Hormozgan University of Medical Sciences. 2012; 16(4):273-282.
13. Zoghi S, Mehrizi A, Ahmad Raeisi, Haghdoost A, Turki H, Safari R *et al*. Survey for asymptomatic malaria cases in low transmission settings of Iran under elimination programme. Malaria Journal. 2012; 11:126. http://www.malariajournal.com/content/11/1/126.
14. Hemati Shabani S, Zakeri S, Abouie Mehrizia A, Mortazavib Y, Dinparast Djadid N. Population genetics structure of Plasmodium vivax circumsporozoite protein during the elimination process in low and unstable malaria transmission areas, southeast of Iran. Acta Tropica. 2016; 160:23-34. http://dx.doi.org/10.1016/j.actatropica.2016.04.006.
15. Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Charrahy Z, Haghdoost AA, Zamani G *et al*. Spatial analysis and mapping of malaria risk in an endemic area, south of Iran: A GIS based decision making for planning of control. Acta Tropica. 2012; 122:132-137. DOI: 10.1016/jactatro pica.2012.01.003.
16. Su T, Mulla MS. Toxicity and effects of microbial mosquito larvicides and larvicidal oil on the development and fecundity of the tadpole shrimp *Triops newberryi* (Packard) (Notostraca: Triopsidae). Journal of Vector Ecology. 2005; 30(1):107-114.
17. Nahlen BL, Low-Beer D. Building to Collective Impact: The Global Fund Support for Measuring Reduction in the Burden of Malaria. The American Journal of Tropical Medicine and Hygiene. 2007; 77(6):321-327.
18. Ferede G, Worku A, Getaneh A, Ahmed A, Haile T, Abdu Y *et al*. Prevalence of Malaria from Blood Smears Examination: A Seven-Year Retrospective Study from Metema Hospital, Northwest Ethiopia. Malaria Research and Treatment, 2013. Article ID 704730. http://dx.doi.org/10.1155/2013/704730.
19. Basseri H, Raeisi A, Ranjbar Khakha M, Pakarai A, Hassanzehi A. Seasonal Abundance and Host-Feeding Patterns of Anopheline Vectors in Malaria Endemic Area of Iran. Journal of Parasitology Research, 2010. Article ID 671291. Doi:10.1155/2010/671291.
20. Abbas Poudat, Ladonni H, Ahmad Raeisi. Possible factors influencing malaria incidence in Bandar Abbas County, during 1998-2002. Journal of Hormozgan University of Medical Sciences. 2006; 10(2):101-110.
21. Metanat M, Sharifi-Mood B. Malaria vivax and Severe Thrombocytopenia in Iran. Iranian Journal of Parasitology. 2010; 5(3):69-70.
22. Azikiwe CCA, Ifezulike CC, Siminialayi IM, Amazu LU, Enye JC, Nwakwunite OE. A comparative laboratory diagnosis of malaria: microscopy versus rapid diagnostic test kits. Asian Pacific Journal of Tropical Biomedicine. 2012; 2(4):307-310. Doi: 10.1016/S2221-1691(12)6002 9-X.
23. Department Health Republic of South Africa. Surveillance Guidelines for Malaria Elimination and Prevention of Reintroduction for South Africa. May, 2012. http://www.nicd. ac.za/ assets/ files /Surveillance%20Guidelines%20for%20Malaria%20Elimination%20and%20Prevention%20of%20Reintroduction%20for%20South%20Africa%20(2012).pdf.