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Full Length Research Paper

Conducting mosquito entomology and vector control training courses in the Eastern Mediterranean Region of World Health Organization for capacity building

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Malaria represents major health problems globally. Vector control measures are among the key interventions used to control and eliminate malaria. Strengthening the competence and skills of the health workers engaged in malaria control programme is critical. Different methods of education and training, including teaching as lecture, face to face, laboratory practice and field works was carried out during the course. The training manual of Malaria Entomology ad Vector Control published by WHO was taught. The manual of WHO was used for training. Vector control is the main activity for control of arthropod-borne diseases. Capacity building is the main components for the mosquito-borne diseases control in different countries. Global organizations with local agencies should facilitate these type of capacity building.

Keywords: Iran, Vector control, Mosquito Entomology

INTRODUCTION

Malaria and other mosquito-borne disease are the major problems worldwide. Malaria presents a major health problem globally. It is estimated that globally 243 million cases of malaria led to 863,000 deaths in 2008 (WHO, 2015). Currently there are proven and effective tools to fight against malaria including vector control measures (WHO, 2015). As these tools are scaled up, malaria endemic countries need to continually update the skills and competence of the health workers engaged in malaria control and elimination.

Malaria is one of the most important communicable diseases transmitted by anopheline mosquitoes (Diptera: Culicidae) to humans. In 2013, there are 97 countries and territories with ongoing malaria transmission, and 7 countries in the prevention of reintroduction phase, making a total of 104 countries and territories in which malaria is presently considered endemic. Based on WHO estimate, 207 million cases of malaria occurred globally in 2012 resulted to 627 000 deaths (WHO, 2015).

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Malaria is one of the important infectious diseases in Iran with an average of about 15000 annual cases in the last decade, while total recorded cases has dropped to less than 500 locally transmitted cases in 2013. More than 80% of malaria cases in Iran are reported from three provinces of Sistan and Baluchistan, Hormozgan, and Kerman in southern and southeastern areas of the country. The most routes of malaria cases are immigration from Afghanistan and Pakistan to southern and southeastern areas of the country (Ministry of Health, annual reports).

Over the last 20 years there has been a dramatic reduction of the malaria burden in I.R. Iran. While in 1991, nearly 100,000 cases were reported, in 2014, only 246 autochthonous cases were reported. All observations indicate that the data reflect the real situation and that the overwhelming majority of cases, which occur, are included in the national system, although there is room for improvement in the surveillance system. The spectacular progress can be ascribed to effective implementation of appropriate curative and preventive control interventions through a strong health care infrastructure. Social and economic development allowing better housing, use of air-conditioning etc. has also played a role.

Locally transmitted cases are now concentrated in the south-eastern part of the country, which are affected by extensive population movement across the border with Pakistan, where malaria control faces serious difficulties. In 2009, I.R. Iran set time-bound elimination objectives for its malaria program. There has been excellent progress since, but the continued risk of importation of malaria cases from Pakistan poses a huge challenge, politically, socially, operationally and technically, to malaria elimination in Iran. The situation in the next decade will be absolute elimination or one where a few small short-lived foci emerge from time to time as a result of importation. The latest number of autochthonous cases in the whole country is 42 including 23 local malaria patients, 7 relapsed cases, 12 imported from the other districts by end of July 2016.

School of Public Health, Tehran University of Medical Sciences with long history of work on malaria and publication of several papers on different aspects of malaria including insecticide resistance monitoring (Vatandoost et al., 2004; Vatandoost et al., 2005; Davari et al., 2006; Hanafi-Bojd et al., 2006; Davari et al.;, 2007; Abai et al., 2008; Hasasan and Hossein, 2010; Vatandoost and Hanafi-Bojd, 2012; Soltani et al., 2013; Lak et al., 2002; Enayati et al., 2003), sibling species, molecular study, new record (Naddaf et al., 2003; Oshaghi et al., 2003; Sedaghat et al., 2003; Azari-Hamidian et al., 2006; Oshaghi et al., 2007; Mehravaran et al., 2011; Naddaf et al., 2012; Dezfouli et al., 2003), novel methods for vector control (Soltani et al., 2008; Omrani et al., 2010 A; Omrani et al., 2010 B; Omrani et al., 2012; Chavshin et al., 2012; Soltani et al., 2012), faunestic study (Moosa-Kazemi et al., 2009; Oshaghi et al., 2011), use of plants for larval control (Hadjiakhoondi et al., 2000; Hadjiakhoondi et al., 2003; Oshaghi et al., 2003; Vatandoost and Vaziri, 2004; Hadjiakhoondi et al., 2005; Hadjiakhoondi et al., 2006; Sadat et al., 2005; Shahi et al., 2010; Khanavi et al., 2011; Sedaghat et al., 2011A; Sedaghat et al., 2011B; Khanavi et al., 2013; Vatandoost et al., 2012) using bednets and long lasting impregnated nets (Vatandoost et al., 2006; Moosa-Kazemi et al., 2007; Rafinejad et al., 2008; Soleimani-Ahmadi et al., 2012A; Soleimani-Ahmadi et al., 2012B; Vatandoost et al., 2013; Vatandoost et al., 2009), morphological studies (Emami et al., 2007; Doosti et al., 2006; Doosti et al., 2007), malaria epidemiology (Vatandoost et al., 2003; Hanafi-Bojd et al., 2010; Hanafi-Bojd et al., 2011; Hemami et al., 2013), ecology of malaria vectors (Vatandoost et al., 2006; Vatandoost et al., 2007; Hanafi-Bojd et al., 2011; Hanafi-Bojd et al., 2012A; Hanafi-Bojd et al., 2012B; Mehravaran et al., 2012; Soleimani-Ahmadi et al., 2013; Soleimani-Ahmadi et al., 2012C; Vatandoost et al., 2011), biodiversity (Oshaghi et al., 2006; Nikookar et al., 2010), community participation (Soleimani-Ahmadi et al., 2012A; Hanafi-Bojd et al., 2011), vector control (Vatandoost et al., 2009), repellent evaluation (Vatandoost and Hanafi-Bojd, 2008), anthropophilic index of malaria vectors (Oshaghi et al., 2006A; Oshaghi et al., 2006B), training (Vatandoost et al., 2004) is designated as malaria training center by WHO. There are several reports on different aspects of malaria vectors recently (Khoshdel-Nezamiha et al., 2014; Chavshin et al., 2014A; Chavshin et al., 2014B; Karimian et al., 2014; Chavshin et al., 2015; Khoshdel-Nezamiha et al., 2016; Shayeghi et al., 2014; Gezelbash et al., 2014; Anjomruz et al., 2014A; Anjomruz et al., 2014B; Soleimani-Ahmadi et al., 2014A; Soleimani-Ahmadi et al., 2014B; Soleimani-Ahmadi et al., 2014B; Soleimani-Ahmadi et al., 2015; Ataie et al., 2015; Fathian et al., 2015; Soltani et al., 2015; Golfakhrabadi et al., 2015; Nikookar et al., 2015A; Nikookar et al., 2015B; Chavshin et al., 2015; Shayeghi et al., 2015; Pirmohammadi et al., 2016; Gorouhi et al., 2015; Abai et al., 2015; Sanei-Dehkordi et al., 2016).

METHODS

The training course was held in Bandar Abbas, Iran and had the overall goal of introducing to the participants basic entomology and vector control techniques as well as practical skills that will enable them to contribute to malaria control and elimination in their respective countries. The module consists 7 learning units including: introduction to malaria entomology, identification of malaria vectors, sampling malaria vectors, vector incrimination and malaria control, malaria vector control, monitoring and management of insecticide resistance, vector control in different malaria epidemiological strata,

Figure 1. Participants and facilitators at the Entomology training course

protocol for mosquito rearing, treatment of insecticide treated nets, geographical reconnaissance, protocol for determining the susceptibility of adult mosquitoes to insecticides: WHO bioassay test Protocol for determining the susceptibility of mosquito larvae to insecticides, test procedures for determining the residual efficacy of insecticides on wall surfaces, test procedures for determining the residual efficacy of insecticides on treated mosquito nets. The course structure generally covered lectures group discussions, practical (field) and laboratory work were used. The course was participatory and interactive. Participants took pre- and post-course examinations. A total of 23 participants selected across different counties of EMR region took part in the course (Figure 1).

The training course commenced on the 26th of December 2012 with the introduction of participants and facilitators. Thereafter, the participants took pre-assessment test to assess their understanding of basic entomology. During the week the participants were taken through lectures. The topics included: Biology and ecology of Anopheline mosquitoes, malaria entomology: Different methods of mosquito collection (adults, larvae) and equipment required, identification of major malaria vectors (egg, larvae and adult stages), laboratory demonstration of mosquito age determination, Identification of major malaria vectors (egg, larvae and adult stages) , study and identification of adult anopheline mosquitoes and larvae collected from the field, Epidemiological Principles (vectorial capacity) of malaria transmission in relation to vector control , vector control: classification of pesticides, formulation of pesticides, different methods of vector control, novel approaches to vector control, how to identify mosquitoes from the African region and on vectorial capacity in relation to malaria transmission.

Fieldwork

The participants were taken to the field to practice how to collect mosquitoes using landing, pyrethrum spray, light trap and exit trap techniques. The participants also did assessment of mosquito breeding sites and larval collections.

The rest of the week was devoted to some lectures and to laboratory work. The topics included mosquito identification, dissections of salivary glands for sporozoites and parity, insecticide susceptibility test on larvae and adult mosquitoes. This was done with supervision from the facilitators.

Practical Demonstrations

The participants practiced how to do human landing and pyrethrum spray collections as well as indoor residual spraying and fogging (Figure 2).

Mosquito identification and processing

Participants were taken through sorting and identification techniques using pictorial diagrams and how to process the mosquito samples for laboratory analysis (Figure3). The participants were also given a recap on the various entomological techniques.

Figure 2. Participant practicing how to do indoor residual spraying on a wall

Figure 3. Participants being taken through sorting and identification of mosquitoes

Training facilities

There were adequate facilities for the delivery of lectures. These include a well-furnished spacious room for lectures with adequate audio-visual equipment, a white board, a slide projector and screen and a dedicated computer for the training. Each participant was provided with a copy of the entomology and vector control module (http://www.who.int/malaria/publications/atoz/9789241505819/en/). The laboratory was well equipped with over 23 dissecting and compound microscopes which made it possible for each participant to individually and independently do the laboratory work. There was enough reference collection of mosquitoes available for practical work.

Evaluation of the course and participants

Almost all the participants through verbal communication rated the entire course as very good, delivery of lectures as excellent and practical demonstrations and fieldwork as good. However, they were of the view that the duration of the entomology module was too short to properly accommodate all the 7 units and 6 annex especially the practical sessions. The onsite accommodation for participants enabled all the activities to be organized on time.

CONCLUSIONS AND RECOMMENDATIONS

In general, based on the assessments and interviews, the entomology and vector control module of the training was well executed within the short time allocated. Also considering the fact that most of the participants were programme managers and medical health professionals who have had very little knowledge on malaria entomology, the course achieved its purpose of providing them with basic information needed for decision making in malaria vector control activities in their respective countries. The participants and facilitators for the first time shared experiences with regard to malaria vector control activities between Africa and Mediterranean continents. Some aspects of the module that needed modification had earlier been discussed with tutors and this has been incorporated into the new version of the module. I will recommend that all the participants should be monitored and given the necessary support to enable them contribute to malaria control and elimination activities in their respective countries.

EVALUATION OF THE PARTICIPANTS

Participants was evaluated by results of post- tests, including all aspects of training. The minimum achievement was 14 of 20. The participant who achieved this score certificate of achievement was provided.

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REFERENCES

Abai MR, Hanafi-Bojd AA, Vatandoost H (2015). Laboratory evaluation of Temephos against *Anopheles stephensi* and *Culexpipiens* larvae in Iran. J. Arthropod-borne. Dis.10(4):510-518.

Abai MR, Mehravaran A, Vatandoost H, Oshaghi MA, Javadian E, Mashayekhi M, et al (2008). Comparative performance of imagicideson *Anopheles stephensi*, main malaria vector in a malarious area, southern Iran. J. Vector Borne. Dis. 45(4):307-312.

Anjomruz M, Oshaghi MA, Pourfatollah AA, Sedaghat MM, Raeisi A, Vatandoost H, et al (2014). Preferential feeding success of laboratory reared *Anopheles stephensi* mosquitoes according to ABO blood group status. Acta. Trop. 140:118-123.

Anjomruz M, Oshaghi MA, Sedaghat MM, Pourfatollah AA, Raeisi A,

Vatandoost H, et al (2014). ABO blood groups of residents and the ABO host choice of malaria vectors in southern Iran. Exp. Parasitol. 136:63-67.

Ataie A, Moosa-Kazemi SH, Vatandoost H, Yaghoobi-Ershadi MR, Bakhshi H, Anjomruz M (2015). Assessing the susceptibility status of mosquitoes (Diptera: Culicidae) in a Dirofilariasisfocus, northwestern Iran. J. Arthropod-borne. Dis. 9(1):7-21.

Azari-Hamidian S, Abai MR, Ladonni H, Vatandoost H, Akbarzadeh K (2006). *Anopheles peditaeniatus* (Leicester) new to the Iranian mosquito fauna with notes on Anopheles hyrcanus group in Iran. J. Am. Mosq. Control Assoc. 22(1):144-146.

Chavshin AR, Dabiri F, Vatandoost H, Bavani MM (2015). Susceptibility of *Anopheles maculipennis* to different classes of insecticides in West Azarbaijan Province, Northwestern Iran.Asian Pacific J. Trop.Biomed. 5(5):403-406.

Chavshin AR, Oshaghi MA, Vatandoost H, Hanafi-Bojd AA, Raeisi A, Nikpoor F (2014). Molecular characterization, biological forms and sporozoite rate of *Anopheles stephensi* in southern Iran. Asian Pacific J. Trop.Biomed. 4(1):47-51.

Chavshin AR, Oshaghi MA, Vatandoost H, Pourmand MR, Raeisi A, Enayati AA, et al (2012). Identification of bacterial microflora in the midgut of the larvae and adult of wild caught *Anopheles stephensi*: a step toward finding suitable paratransgenesis candidates. Acta.Trop. 121(2):129-134.

Chavshin AR, Oshaghi MA, Vatandoost H, Pourmand MR, Raeisi A, Terenius O (2014). Isolation and identification of culturable bacteria from wild *Anopheles culicifacies*, a first step in a paratransgenesis approach. Parasit.Vectors.7:419.

Chavshin AR, Oshaghi MA, Vatandoost H, Yakhchali B, Zarenejad F, Terenius O (2015). Malpighian tubules are important determinants of Pseudomonas transstadial transmission and longtime persistence in *Anopheles stephensi*.Parasit.Vectors. 8:36.

Davari B, Vatandoost H, Ladonni H, Shaeghi M, Oshaghi M, Basseri H, et al (2006). Comparative efficacy of different imagicides against different strains of *Anopheles stephensi* in the malarious areas of Iran, 2004-2005. Pak. J. Biol. Sci. 9(5):885-892.

Davari B, Vatandoost H, Oshaghi M, Ladonni H, Enayati A, Shaeghi M, et al (2007). Selection of *Anopheles stephensi* with DDT and dieldrin and cross-resistance spectrum to pyrethroids and fipronil. Pestic. Biochem. Physiol. 89(2):97-103.

Dezfouli SR, Oshaghi MA, Vatandoost H, Assmar M (2003). rDNA-ITS2

based species-diagnostic polymerase chain reaction assay for identification of sibling species of *Anopheles fluviatilis* in Iran. The Southeast Asian J. Trop. Med. Public. Health. 34Suppl 2:56-60.

Doosti S, Azari-Hamidian S, Vatoost H, Hosseini MOM (2006). Taxonomic differentiation of *Anopheles sacharovi* and *An.maculipennis*sl (Diptera: Culicidae) larvae by seta 2 (antepalmatehair). Acta. Med. Iran. 44(1):21-27.

Doosti S, Vatandoost H, Oshaghi M, Hosseini M, Sedaghat M (2007). Applying morphometric variation of seta 2 (Antepalmate Hair) among the larvae of the members of the Maculipennis Subgroup (Diptera: Culicidae) in Iran.J. Arthropod-borne. Dis. 1(1):28-37.

Emami SN, Vatandoost H, Oshaghi MA, Mohtarami F, Javadian E, Raeisi A (2007). Morphological method for sexing anopheline larvae. J. Vector Borne Dis. 44(4):245-249.

Enayati AA, Vatandoost H, Ladonni H, Townson H, Hemingway J (2003). Molecular evidence for a kdr-like pyrethroid resistance mechanism in the malaria vector mosquito *Anopheles stephensi*. Med. Vet. Entomol. 17(2):138-144.

Fathian M, Vatandoost H, Moosa-Kazemi SH, Raeisi A, Yaghoobi-Ershadi MR, Oshaghi MA, et al (2015). Susceptibility of Culicidae mosquitoes to some insecticides recommended by WHO in a malaria endemic area of southeastern Iran. J. Arthropod-borne.Dis. 9(1):22-34.

Gezelbash Z, Vatandoost H, Abai MR, Raeisi A, Rassi Y, Hanafi-Bojd AA, et al (2014). Laboratory and field evaluation of two formulations of *Bacillus thuringiensis* M-H-14 against mosquito larvae in the Islamic Republic of Iran, 2012.East .Mediterr.Health J. 20(4):229-235.

Golfakhrabadi F, Khanavi M, Ostad SN, Saeidnia S, Vatandoost H, Abai MR, et al (2015). Biological Activities and Composition of Ferulago carduchorum Essential Oil. J. Arthropod-borne. Dis. 9(1):104-115.

Gorouhi MA, Vatandoost H, Oshaghi MA, Raeisi A, Enayati AA, Mirhendi H, et al (2015). Current susceptibility status of *Anopheles stephens*i (Diptera: Culicidae) to different imagicides in a malarious area, southeastern Iran. J. Arthropod-borne. Dis. 10(4).493-500.

Hadjiakhoondi A, Aghel N, Zamanizadeh-Nadgar N, Vatandoost H (2000). Chemical and biological study of *Menthaspicatal* essential oil from Iran. DARU J. Pharm. Sci. 8(1-2):19-21.

Hadjiakhoondi A, Vatandoost H, Jamshidi A, Amiri EB (2003). Chemical constituents of efficacy of *CymbopogonOlivieri* (Boiss) bar essential oilagainst malaria vector, *Anopheles stepensi*. DARU J. Pharm. Sci. 11(3):125-128.

Hadjiakhoondi A, Vatandoost H, Khanavi M, Abaee MR, Karami M (2005). Biochemical investigation of different extracts and larvicidal activity of *Tagetesminuta* L. on *Anopheles stephensi* larvae. Iran. J. Pharm. Sci. 1(2):81-84.

Hadjiakhoondi A, Vatandoost H, Khanavi M, SadeghipourRoodsari HR, Vosoughi M, Kazemi M, et al (2006). Fatty acid composition and toxicity of *Meliaazedarach* L. fruits against malaria vector *Anopheles stephensi*. Iran. J. Pharm. Sci. 2(2):97-102.

Hanafi-Bojd A, Vatandoost H, Philip E, Stepanova E, Abdi A, Safari R, et al (2010). Malaria situation analysis and stratification in Bandar Abbas county, southern Iran, 2004-2008. Iran. J. Arthropod-borne. Dis4(1):31-41.

Hanafi-Bojd AA, Azari-Hamidian S, Vatandoost H, Charrahy Z (2011). Spatio-temporal distribution of malaria vectors (Diptera: Culicidae) across different climatic zones of Iran. Asian Pacific J. Trop.Med. 4(6):498-504.

Hanafi-Bojd AA, Vatandoost H, Jafari R (2006). Susceptibility status of *Anopheles dthali* and *An. fluviatilis* to commonly used larvicides in an endemic focus of malaria, southern Iran. J. Vector Borne Dis.43(1):34-38.

Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Charrahy Z, Haghdoost AA, Sedaghat MM, et al (2012). Larval habitats and biodiversity of anopheline mosquitoes (Diptera: Culicidae) in a malarious area of southern Iran. J. Vector Borne Dis. 49(2):91-100.

Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Eshraghian MR, Haghdoost AA, Abedi F, et al (2011). Knowledge, attitudes and practices regarding malaria control in an endemic area of southern Iran. The Southeast Asian J. Trop.Med.Public Health.42(3):491-501.

Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Haghdoost AA, Shahi M, Sedaghat MM, et al (2012). Entomological and epidemiological attributes for malaria transmission and implementation of vector control in southern Iran. Acta.Trop. 121(2):85-92.

Hemami MR, Sari AA, Raeisi A, Vatandoost H, Majdzadeh R (2013). Malaria elimination in iran, importance and challenges. Int. J. Preventive Med. 4(1):88-94.

Karimian F, Oshaghi MA, Sedaghat MM, Waterhouse RM, Vatandoost H, Hanafi-Bojd AA, et al (2014). Phylogenetic analysis of the oriental-Palearctic-Afrotropical members of Anopheles (Culicidae: Diptera) based on nuclear rDNA and mitochondrial DNA characteristics. Jap. J. Infect. Dis. 67(5):361-367.

Khanavi M, Toulabi PB, Abai MR, Sadati N, Hadjiakhoondi F, Hadjiakhoondi A, et al (2011). Larvicidal activity of marine algae, *Sargassumswartzii* and *Chondriadasyphylla*, against malaria vector *Anopheles stephensi*. J. Vector Borne Dis. 48(4):241-244.

Khanavi M, Vatandoost H, KhosraviDehaghi N, SaneiDehkordi A, Sedaghat MM, Hadjiakhoondi A, et al (2013). Larvicidal activities of some Iranian native plants against the main malaria vector, *Anopheles stephensi*. Acta. Med. Iran. 51(3):141-147.

Khoshdel-Nezamiha F, Vatandoost H, Azari-Hamidian S, Bavani MM, Dabiri F, Entezar-Mahdi R, et al (2014). Fauna and larval habitats of mosquitoes (Diptera: Culicidae) of west Azerbaijan province, northwestern Iran. J. Arthropod-borne. Dis. 8(2):163-173.

Khoshdel-Nezamiha F, Vatandoost H, Oshaghi MA, Azari-Hamidian S, Mianroodi RA, Dabiri F, et al (2016). Molecular characterization of mosquitoes (Diptera: Culicidae) in northwestern Iran by using rDNAITS2.Jap.J. Infect. Dis. 69(4):319-322.

Lak SS, Vatandoost H, Entezarmahdi M, Ashraf H, Abai M, Nazari M (2002). Monitoring of insecticide resistance in *Anopheles sacharovi* (Favre, 1903) in borderline of Iran, Armenia, Naxcivan and Turkey, 2001. Iranian J. Public Health. 31(3-4):96-99.

Mehravaran A, Oshaghi MA, Vatandoost H, Abai MR, Ebrahimzadeh A, RoodiAM, et al (2011). First report on *Anopheles fluviatilis* U in southeastern Iran. Acta.Trop. 117(2):76-81.

Mehravaran A, Vatandoost H, Oshaghi MA, Abai MR, Edalat H, Javadian E, et al (2012). Ecology of *Anopheles stephensi* in a malarious area, southeast of Iran. Acta. Med. Iran. 50(1):61-65.

Moosa-Kazemi S, Vatandoost H, Nikookar H, Fathian M (2009). Culicinae (Diptera: culicidae) mosquitoes in chabahar county, sistan and baluchistan province, southeastern iran. Iran. J. Arthropod-borne. Dis. 3(1):29-35.

Moosa-Kazemi S, Vatandoost H, Raeisi A, Akbarzadeh K (2007). Deltamethrin impregnated bed nets in a malaria control program in Chabahar, Southeast Baluchistan, IR Iran.J. Arthropod-borne. Dis. 1(1):43-51.

Naddaf SR, Oshaghi MA, Vatandoost H (2012). Confirmation of two siblingspecies among *Anopheles fluviatilis*mosquitoes in south and southeastern Iran by analysis of cytochrome oxidase I gene. J. Arthropod-borne. Dis. 6(2):144-150.

Naddaf SR, Oshaghi MA, Vatandoost H, Assmar M (2003). Molecular characterization of *Anopheles fluviatilis* species complex in the Islamic Republic of Iran. Eastern Mediterra. Health. J. 9(3):257-265.

Nikookar S, Moosa-Kazemi S, Oshaghi M, Yaghoobi-Ershadi M, Vatandoost H, Kianinasab A (2010). Species composition and diversity of mosquitoes in neka county, mazandaran province, northernIran. Iran. J. Arthropod-borne. Dis. 4(2):26-34.

Nikookar SH, Moosa-Kazemi SH, Oshaghi MA, Vatandoost H, Yaghoobi-Ershadi MR, Enayati AA, et al (2015). Biodiversity of culicid mosquitoes in rural Neka township of Mazandaran province, northern Iran. J. Vector Borne Dis. 52(1):63-72.

Nikookar SH, Moosa-Kazemi SH, Yaghoobi-Ershadi MR, Vatandoost H, Oshaghi MA, Ataei A, et al (2015). Fauna and larval Hhabitat characteristics of mosquitoes in Nekacounty, northern Iran. J. Arthropod-borne. Dis. 9(2):253-266.

Omrani SM, Vatandoost H, Oshaghi M, Shokri F, Yaghoobi-Ershadi M, Rassi Y, et al (2010). Differential responses of *Anopheles stephensi* (Diptera: Culicidae) to skin emanations of a man, a cow, and a guinea pig in the olfactometer. Iran. J. Arthropod-borne. Dis. 4(1):1-16.

Omrani SM, Vatandoost H, Oshaghi MA, Rahimi A (2012). Upwind responses of Anopheles stephensi to carbon dioxide and L-lactic acid: an olfactometer study. East. Mediterr. Health. J. 18(11):1134-1142.

Omrani SM, Vatandoost H, Oshaghi MA, Shokri F, Guerin PM, Yaghoobi Ershadi MR, et al (2010). Fabrication of an olfactometer for mosquito behavioural studies. J. Vector Borne Dis. 47(1):17-25.

World Health Organization WHO (2015). World Malaria Report: 2012. Geneva: WHO, 2012. Fecha de consulta. 23:247.

Oshaghi M, Ghalandari R, Vatandoost H, Shayeghi M, Kamali-Nejad M, Tourabi-Khaledi H, et al (2003). Repellent effect of extracts and essential oils of *Citrus limon* (Rutaceae) and *Melissa officinalis* (Labiatae) against main malaria vector, *Anopheles stephensi* (Diptera: Culicidae). Ira J. Public Health. 32(4):47-52.

Oshaghi MA, Chavshin AR, Vatandoost H (2006). Analysis of mosquito bloodmeals using RFLP markers. Exp. Parasitol. 114(4):259-264.

Oshaghi MA, Chavshin AR, Vatandoost H, Yaaghoobi F, Mohtarami F, Noorjah N (2006). Effects of post-ingestion and physical conditions on PCR amplification of host blood meal DNA in mosquitoes. Exp. Parasitol. 112(4):232-236.

Oshaghi MA, Sedaghat MM, Vatandoost H (2003). Molecular characterization of the *Anopheles maculipennis* complex in the Islamic Republic of Iran. East. Mediterr. Health . J. 9(4):659-666.

Oshaghi MA, Shemshad K, Yaghobi-Ershadi MR, Pedram M, Vatandoost H, Abaie MR, et al (2007). Genetic structure of the malaria vector *Anopheles superpictus* in Iran using mitochondrial cytochrome oxidase (COI and COII) and morphologic markers: a new species complex? Acta. Trop. 101(3):241-248.

Oshaghi MA, Vatandoost H, Gorouhi A, Abai MR, Madjidpour A, Arshi S, et al (2011). Anopheline species composition in borderline of Iran Azerbaijan. Acta.Trop. 119(1):44-49.

Pirmohammadi M, Shayeghi M, Vatandoost H, Abaei MR, Mohammadi A, Bagheri A, et al (2016). Chemical composition and repellent activity of *Achilleavermiculata* and *Saturejahortensis* against *Anophelesstephensi*. J. Arthropod-borne. Dis. 10(2):201-210.

Rafinejad J, Vatandoost H, Nikpoor F, Abai MR, Shaeghi M, Duchen S, et al (2008). Effect of washing on the bioefficacy of insecticide-treated nets (ITNs) and long-lasting insecticidal nets (LLINs) against main malaria vector *Anopheles stephensi* by three bioassay methods. J. Vector Borne Dis. 45(2):143-150.

Sadat Ebrahimi S, Hadjiakhoondi A, Rezazadeh S, Fereidunian N, Vatandoost H, Abaee M (2005). The components of *Tagetesminuta* L. and its biological activities against malaria vector, *Anopheles stephensi* in Iran. J. Med. Plants. 4(16):43-47.

Sanei-Dehkordi A, Vatandoost H, Abaei MR, Davari B, Sedaghat MM (2016). Chemical composition and larvicidalactivity of *Bunium persicum*essential oil against two important mosquitoes vectors. J. Essent. Oil. Bear. Pl. 19(2):349-357.

Sedaghat M, Dehkordi AS, Abai M, Khanavi M, Mohtarami F, Abadi YS, et al (2011). Larvicidal Activity of Essential Oils of Apiaceae Plants against Malaria Vector, *Anopheles stephensi*. Iran. J. Arthropod-borne. Dis. 5(2):51-59.

Sedaghat MM, Dehkordi AS, Khanavi M, Abai MR, Mohtarami F, Vatandoost H (2011). Chemical composition and larvicidal activity of essential oil of *Cupressusarizonica* E.L. Greene against malaria vector *Anopheles stephensi* Liston (Diptera: Culicidae). Pharm. Res. 3(2):135-139.

Sedaghat MM, Linton YM, Oshaghi MA, Vatandoost H, Harbach RE (2003). The *Anopheles maculipennis* complex (Diptera: Culicidae) in Iran: molecular characterization and recognition of a new species. Bull. Entomol. Res. 93(6):527-535.

Shahi M, Hanafi-Bojd AA, Iranshahi M, Vatandoost H, Hanafi-Bojd MY (2010). Larvicidal efficacy of latex and extract *of Calotropisprocera* (Gentianales: Asclepiadaceae) against *Culexquinquefasciatus* and *Anopheles stephensi* (Diptera: Culicidae). J. Vector borne. Dis. 47(3): 185-188.

Shayeghi M, Nejati J, Shirani-Bidabadi L, Koosha M, Badakhshan M, Bavani MM, et al (2015). Assessing the fauna of aquatic insects for possibleuse for malaria vector control in large river, central Iran. Acta. Med. Iran. 53(9):523-532.

Shayeghi M, Vatandoost H, Gorouhi A, Sanei-Dehkordi AR, Salim-Abadi Y, Karami M, et al (2014). Biodiversity of aquatic insects of Zayandeh Roudriver and its branches, Isfahan Province, Iran. J. Arthropod-borne. Dis. 8(2):197.

SoleimaniAhmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR, et al (2012). Effects of educational intervention on long-lasting insecticidal nets use in a malarious area, southeast Iran. Acta. Med. Iran. 50(4):279-287.

Soleimani-Ahmadi M, Vatandoost H, Hanafi-Bojd AA, Zare M, Safari R, Mojahedi A, et al (2013). Environmental characteristics of anopheline mosquito larval habitats in a malaria endemic area in Iran. Asian Pacific J. Trop. Med. 6(7):510-515.

Soleimani-Ahmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR, et al (2012). Field evaluation of permethrin longlasting insecticide treated nets (Olyset((R))) for malaria control in an endemic area, southeast of Iran. Acta.Trop. 123(3):146-153.

Soleimani-Ahmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR, et al (2012). Vector ecology and susceptibility in a malaria-endemic focus in southern Islamic Republic of Iran. East. Mediterr. Health. J. 18(10):1034-1041.

Soleimani-Ahmadi M, Vatandoost H, Zare M (2014). Characterization of larval habitats for anopheline mosquitoes in a malarious area under elimination program in the southeast of Iran. Asian Pacific J. Trop. Biomed. 4(Suppl 1):S73-80.

Soleimani-Ahmadi M, Vatandoost H, Zare M, Alizadeh A, Salehi M (2014). Community knowledge and practices regarding malaria and long-lasting insecticidal nets during malaria elimination programme in an endemic area in Iran. Mal. J. 13:511.

Soleimani-Ahmadi M, Vatandoost H, Zare M, Turki H, Alizadeh A (2015). Topographical distribution of anopheline mosquitoes in an area under elimination programme in the south of Iran. Mal. J. 14:262.

Soleimani-Ahmadi M, Vatandoost H, Zare M, Turki H, Alizadeh A (2015). Topographical distribution of anopheline mosquitoes in an area under elimination programme in the south of Iran. Mal. J.14(1):1.

Soltani A, Vatandoost H, Jabbari H, Mesdaghinia A, Mahvi A, Younesian M, et al (2008). Use of expanded polystyrene (EPS) and shredded waste polystyrene (SWAP) beads for control of mosquitoes. J. Arthropod-borne. Dis. 2(2):12-20.

Soltani A, Vatandoost H, Jabbari H, Mesdaghinia AR, Mahvi AH, Younesian M, et al (2012). Field efficacy of expanded polystyrene and shredded waste polystyrene beads for mosquito control in artificial pools and field trials, Islamic Republic of Iran. East. Mediterr. Health. J.18(10):1042-1048.

Soltani A, Vatandoost H, Oshaghi MA, Enayati AA, Raeisi A, Eshraghian MR, et al (2013). Baseline susceptibility of different geographicalstrains of *Anopheles stephensi* (Diptera: Culicidae) to Temephos in malariousareas of Iran. J. Arthropod-borne. Dis.7(1):56-65.

Soltani A, Vatandoost H, Oshaghi MA, Ravasan NM, Enayati AA, Asgarian F (2015). Resistance mechanisms of *Anopheles stephensi* (Diptera: Culicidae) to Temephos. J. Arthropod-borne. Dis. 9(1):71-83.

Vatandoost H, Abai MR, Abbasi M, Shaeghi M, Abtahi M, Rafie F (2009). Designing of a laboratory model for evaluation of the residual effects of deltamethrin (K-othrine WP 5%) on different surfaces against malaria vector, *Anopheles stephensi* (Diptera: Culicidae). J. Vector Borne Dis. 46(4):261-267.

Vatandoost H, Ashraf H, Lak SH, Mahdi RE, Abai MR, Nazari M (2003). Factors involved in the re-emergence of malaria in borderline of Iran, Armenia, Azerbaijan and Turkey.The Southeast Asian J. Trop. Med. Pub. Health. 34 Suppl 2:6-14.

Vatandoost H, Dehakia M, Djavadia E, Abai MR, Duchson S (2006). Comparative study on the efficacy of lambdacyhalothrin and bifenthrin on torn nets against the malaria vector, *Anopheles stephensi* as assessed by tunnel test method. J. Vector Borne Dis. 43(3):133-135.

Vatandoost H, Emami SN, Oshaghi MA, Abai MR, Raeisi A, Piazzak N, et al (2011). Ecology of malaria vector *Anopheles culicifacies* in a malarious area of SistanvaBaluchestan province, south-east Islamic Republic of Iran. East. Mediterr. Health. J. 17(5):439-445.

Vatandoost H, Hanafi-Bojd AA (2008). Laboratory evaluation of 3 repellents against *Anopheles stephensi* in the Islamic Republic of Iran. East. Mediterr. Health. J. 14(2):260-267.

Vatandoost H, Hossein ZA (2010). Responsiveness of *Anopheles maculipennis* to different imagicides during resurgent malaria. Asian Pacific J. Trop. Med. 3(5):360-363.

Vatandoost H, Hanafi-Bojd AA (2012). Indication of pyrethroid resistance in the main malaria vector, *Anopheles stephensi* from Iran. Asian Pacific J. Trop. Med. 5(9):722-776.

Vatandoost H, Mamivandpoor H, Abai MR, Shayeghi M, Rafi F, Raeisi A, et al (2013). Wash Resistance and Bioefficacy of Alphacypermethrin Long Lasting Impregnated Nets (LLIN-Interceptor against *Anopheles stephensi* using tunnel test. J. Arthropod-borne. Dis. 7(1):31-45.

Vatandoost H, Mashayekhi M, Abaie MR, Aflatoonian MR, Hanafi-Bojd AA, Sharifi I (2005). Monitoring of insecticides resistance in main malaria vectors in a malarious area of Kahnooj district, Kerman province, southeastern Iran. J. Vector Borne Dis. 42(3):100-108.

Vatandoost H, Mesdaghinia AR, Zamani G, Madjdzadeh R, Holakouie K, Sadrizadeh B, et al (2004). Development of the Regional Malaria Training Centre in Bandar-e Abbas, Islamic Republic of Iran. East. Mediterr. Health. J.10(1-2):215-224.

Vatandoost H, Oshaghi MA, Abaie MR, Shahi M, Yaaghoobi F, Baghaii M, et al (2006). Bionomics of *Anopheles stephensi* Liston in the malarious area of Hormozgan province, southern Iran, 2002. Acta Trop. 97(2):196-203.

Vatandoost H, Ramin E, Rassi Y, Abai M (2009). Stability and wash resistance of local made mosquito bednets and detergents treated with Pyrethroids against susceptible strain of malaria vector *Anopheles stephensi*. Iran J. Arthropod-borne. Dis. 3(1):19-28.

Vatandoost H, SaneiDehkordi A, Sadeghi SM, Davari B, Karimian F, Abai MR, et al (2012). Identification of chemical constituents and larvicidal activity of *Kelussiaodoratissima* Mozaffarian essential oil against two mosquito vectors *Anopheles stephensi* and *Culexpipiens* (Diptera: Culicidae). Exper.Parasitoy. 132(4):470-474.

Vatandoost H, Shahi H, Abai MR, Hanafi-Bojd AA, Oshaghi MA, Zamani G (2004). Larval habitats of main malaria vectors in Hormozgan province and their susceptibility to different larvicides. The Southeast Asian J. Trop. Med. Pub. Health. 35 Suppl. 2:22-25.

Vatandoost H, Shahi M, Hanafi-Bojd A, Abai M, Oshaghi M, Rafii F (2007). Ecology of *Anopheles dthali* Patton in Bandar abbas district, Hormozgan province, southern Iran. J. Arthropod-borne. Dis. 1(1):21-27.

Vatandoost H, Vaziri VM (2004). Larvicidal activity of a neem tree extract (Neemarin) against mosquito larvae in the Islamic Republic of Iran East. Mediterr. Health. J.10(4-5):573-581.