

Plasmodium vivax within European borders

Aitor Olaso-Bengoechea¹, María F López-Ballero² and Teresa Ferrer-Gimeno³

¹Public Health Inspector, Sección Sanidad Ambiental, Instituto Salud Pública y Laboral Navarra (ISPLN), Spain

²Medical Doctor, Hospital San Juan de Dios, Pamplona, Spain

³Head of Section Sanidad Ambiental, Instituto de Salud Pública y Laboral Navarra (ISPLN), Spain

Malaria disease [1] is a life-threatening infectious disease caused by parasites of the *Plasmodium* genus, transmitted through the bite of the infected female *Anopheles* mosquito. Among the five [1] parasites species that cause malaria in humans (*Plasmodium falciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi*), two [2] pose the greatest threat: *P. falciparum* is responsible for 99% of malaria deaths globally and, *P. vivax*, represent the most dominant malaria parasite in most countries outside of sub-Saharan Africa.

Common symptoms of malaria are high fever, headache, diarrhoea, chills and vomiting, which may manifest themselves in some 1-4 weeks after infection. *P. falciparum* malaria causes anaemia and, left untreated, may rapidly progress to severe illness and death. On the contrary, *P. vivax* malaria is less aggressive, but could relapse, which may occur months and in some cases, to years later.

Nowadays, it is a preventable and curable disease but, a fully tested vaccine is not yet authorised in any region in the world. In Europe, malaria remains a rare [3] disease in terms of prevalence, but existence of *P. vivax* malaria occurred [4] since the first outbreak [1] in Greece in 2009.

Although malaria was eradicated from Greece in the 1970's [5], different factors such increasingly temperature warming might favour mosquito proliferation and parasite development, together with new risks [4] such are massive refugee's crisis and migrant populations flow from endemic or epidemic areas could contribute to building up of a *P. vivax* reservoir. From 2009, *P. vivax* malaria has re-emerged [1,4] in areas of Greece that were hotspots of malaria before its eradication, in persons without travel history to a malaria endemic country. Autochthonous [3] malaria occurs when a human is infected in a malaria-free area, which has been transmitted by a vector-borne (*Anopheles* mosquito) from another human who has been previously infected from a malaria endemic or epidemic area. A number of Public Health measures were implemented since 2012 [4] to prevent re-establishment of the disease in the country.

Table 1 shows the number of total malaria cases in the last 5 years (period 2012-2016), overall remaining less of a hundred cases yearly and includes imported malaria cases of *P. vivax* and *P. falciparum* in the

Table 1. Total malaria cases reported from 2012-2016 in Greece

Year	Plasmodium species					Total malaria cases
	<i>P.vivax</i>			<i>P.falciparum</i> (imported)	Other/ Unspecified (imported)	
	Total	Imported	Autochthonous			
2012	74	54	20	16	3	93
2013	12	9	3	12	1	25
2014	6	6	0	31	1	38
2015 ^a	20	19	1 ^c	9	1	30
2016 ^b	68	63	5	19	1	88

^aUp to 26/8/2015

^bUp to 12/9/2016

^cThere were 6 cases at the end of the year [4].

whole period. Also, it includes the total *P. vivax* cases and *P. falciparum* cases. All *P. falciparum* cases were imported malaria, whereas *P. vivax* malaria cases combined imported and autochthonous cases. Zero local-acquired autochthonous malaria was reported in 2014 only.

In conclusion, it can be said that autochthonous malaria remains active in Greece since 2009, with an exception of zero cases reported in 2014. Among all malaria cases in Greece (imported and autochthonous), all autochthonous cases were caused by *Plasmodium vivax*. This autochthonous malaria presence may suggest an existing *P. vivax* parasite reservoir in the area together with existence of the mosquito vector, probably boosted by the European refugee crisis and migration flow. This situation will need further surveillance.

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Correspondence to: Aitor Olaso-Bengoechea, Public Health Inspector, Sección Sanidad Ambiental, Instituto Salud Pública y Laboral Navarra (ISPLN), Spain, E-mail: aitorolaso@gmail.com

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