Malaria knowledge, attitudes and practices among migrants from malaria-endemic countries in Evrotas, Laconia, Greece, 2013

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Following re-emergence of malaria in Evrotas, Laconia, in 2009–12, a malaria-control programme was implemented in 2011–12 targeting migrants from malaria-endemic countries, including house-to-house active case detection, health education and distribution of mosquito protection items. In June 2013, we surveyed migrants in Evrotas to assess their malaria knowledge, attitudes and practices to guide prevention activities. We selected participants using simple random sampling and interviewed them, using structured questionnaires. We defined mosquito protection practices (MPPs) as the use of full-length clothes/topical repellent, mosquito screens, fans or air-conditioning, and insecticides. We calculated prevalence ratios (PRs) using Poisson regression and we allowed for clustering of participants in a residence. Of 654 migrants, we invited 132 and 130 participated (all men; 120 (92%) from Pakistan). Of the 130, 56 (43%) identified fever as a malaria symptom; those who were aware of this had higher level of education (PR: 3.2; 95% confidence interval (CI): 1.2–9.0). A total of 111 (85%) used insecticide-treated bednets and 95 (73%) used more than two MPPs. Poor housing conditions (warehouses/shacks: PR: 0.8; 95% CI: 0.6–0.9), were associated with use of up to two MPPs. Despite extensive interventions in Evrotas, the level of malaria awareness among migrants remained suboptimal and poor housing conditions hindered effective mosquito protection. We recommend culturally adapted health education and improvement of housing conditions to minimise the risk of new cases and re-establishment of malaria in Greece.

Introduction

In 2012, the World Health Organization (WHO) estimated that malaria caused 207 million infections and 627,000 deaths globally [1]. In Europe, most cases are attributed to migration and international travel [2], although from 1998 to 2010, parts of southern Europe reported sporadic autochthonous cases [3]. Environmental conditions in southern Europe favour breeding of anopheline vectors of malaria, allowing for transmission of the *Plasmodium* parasites [4,5]. The carriage of *Plasmodium* by travellers and migrants from malaria-endemic areas favours the potential for local transmission under suitable ecological conditions [6]. In 1974, WHO declared Greece malaria free [7]; however, in 2009–12, 53 locally acquired and 40 imported cases of *Plasmodium vivax* malaria occurred in Evrotas, Laconia, in southern Peloponnese, a rural and historically malaria-prone area [8]. Genotyping analysis of *P. vivax* from blood specimens from autochthonous and imported cases in Evrotas in 2011 indicated that there had been multiple introductions of several south-east Asian strains of *P. vivax* and local transmission had occurred [9]. During the May to October transmission period [10] of 2013, Evrotas was host to a community of 554 to 859 male migrant farm workers from the Indian subcontinent, predominantly Pakistan. This population was mobile, with a high turnover of people and fluctuating numbers throughout the year [11]. Most of the migrants were undocumented and worked in local orchards. Many lived in crowded, poorly constructed buildings, often located close to mosquito breeding sites [10].

Since October 2011, a mobile team based in Evrotas from the Hellenic Centre for Disease Control and

TABLE 1

Socio-demographic and household characteristics of migrant study participants, Evrotas, Greece, June 2013 (n = 130)^a

Characteristic	Number (%)	95% CI
Country of origin		
Pakistan	120 (92)	86–96
Afghanistan	4 (3)	1–8
Bangladesh	4 (3)	1–8
Morocco	2 (2)	0–5
Village of residence		
Skala	77 (59)	50–68
Elos	31 (24)	17–32
Leimonas	8 (6)	3–12
Vlachioti	6 (5)	2–10
Taxiarches	5 (4)	1–9
Agios Georgios	3 (2)	0–7
Age group in years		
18–24	48 (37)	29–46
25–34	62 (48)	39–57
≥35	20 (15)	10–23
Length of education in years		
0	18 (14)	8–21
1–6	52 (40)	32–49
7–12	60 (46)	37–55
Marital status		
Single	99 (76)	68–83
Profession		
Casual farm worker	128 (98)	95–100
Medical insurance		
Had insurance	4 (3)	1–8
Type of residence		
House/flat	68 (52)	43–61
Warehouse/shack	62 (48)	39–57
Mosquito screens on windows and doors		
None	59 (45)	37–54
Some	61 (47)	38–56
All	10 (8)	4–14
Other residence characteristics		
Had a fan or air conditioning	111 (85)	78–91
Had an outdoor area, e.g. yard, garden, etc.	123 (95)	89–98
Had unkept and overgrown bushes/plants (n = 123)	71 (58)	48–67
Had an outdoor area with water ^b (n = 123)	63 (51)	42–60

CI: confidence interval.

^a Unless otherwise specified.

^b Irrigation channels, ditches, wells, stagnant water, water containers.

Prevention (HCDCP) (from April to December 2011 and still ongoing in 2015) and the nongovernmental organisation Médecins Sans Frontières (MSF) (from April to October 2012) have carried out field work on active case detection (ACD) in the area and have implemented an integrated malaria control programme in Evrotas targeting the local and migrant communities. This included the deployment of a field team that created a regularly updated registry of all migrants from malaria-endemic and North African countries, conducted fortnightly door-to-door visits for ACD among migrants and set up a hotline for queries for the public. The vector control programme included indoor residual spraying (IRS) and distribution of mosquito coils and indoor mosquito vaporising mats and additionally, in 2013, distribution and monitoring of use of long-lasting insecticide-treated bednets (LLINs) (otherwise unavailable and not authorised for sale in Greece) to migrant residents. The team provided information on malaria and protection measures against mosquitoes to local and migrant residents, through home visits, public meetings, presentations to schools, TV and radio spots [10,12,13]. However, the impact of these health education and vector control activities had not been evaluated, and little was known about the level of awareness of malaria, mosquito protection practices (MPPs) and health-seeking behaviour among this migrant community [10]. As migrant populations are particularly vulnerable to contracting malaria, given their poor living conditions, their access to healthcare and their fragile legal status in the country, in June 2013, we surveyed migrant residents of Evrotas born in malaria-endemic countries and North Africa, to assess their knowledge, attitudes and practices in order to guide public health prevention activities and community sensitisation campaigns.

Methods

Study area and population

Evrotas is an agricultural river delta area (2011 population: 17,755) [14] with dense irrigation and drainage channels and abundant mosquito populations, including *Anopheles* spp. in low but increasing numbers in September and October [8]. The *Anopheles* mosquito in Greece is anthropophilic, nocturnal, bites both indoors and outdoors and is not considered a nuisance mosquito [15]. The predominant species in Evrotas is *An. sacharovi*, a competent malaria vector [16]. Evrotas is served by one health centre and the nearest regional hospital is in the city of Sparta, 37 km away.

The study population included the migrant residents of six villages (Skala, Elos, Vlachioti, Leimonas, Taxiarches and Agios Georgios) targeted for ACD during the May to October 2013 transmission period. We defined migrant residents as individuals over 18 years of age, born in malaria-endemic or North African countries and who had resided in one of the study villages for three months or more.

TABLE 2

Malaria awareness and attitudes towards malaria among migrant study participants in Evrotas, Greece, June 2013 (n = 130)^a

Awareness or attitude	Number/Total (%) ^b	95% CI
Heard about malaria in the past	117/130 (90)	84–95
Heard about malaria from:		
ACD teams	94/117 (80)	72–87
Country of origin	59/117 (50)	41–60
Friend/family	28/117 (24)	17–33
Media ^c	5/117 (4)	1–10
Healthcare facility	4/117 (3)	1–9
Malaria present in country of origin		
Yes	100/130 (77)	69–84
No	16/130 (12)	7–19
Don't know	14/130 (11)	6–17
History of malaria		
Yes	9/130 (7)	3–13
Place where malaria symptoms appeared		
Greece	5/9 (56)	21–86
Country of origin	4/9 (44)	14–79
Other		
Awareness of malaria cases in Evrotas	115/128 (90)	83–94
Worried about becoming seriously ill (themselves or family/household member) with malaria	79/129 (61)	52–70
Worried that mosquito control insecticides are harmful to health	13/129 (10)	5–17
Satisfied with malaria information provided by authorities	129/129 (100)	97–100
Satisfied with malaria prevention methods taken by authorities	129/129 (100)	97–100

ACD: active case detection; CI: confidence interval.

^a Unless otherwise specified.

^b Some percentages do not add up to 100 because of multiple responses.

^c Newspaper, radio, television, Internet, poster.

Sampling

We selected participants using simple random sampling from the May 2013 HCDCP registry of migrants in Evrotas. Assuming 50% of the migrant population had knowledge of malaria, with 8% precision, a design effect of 1, a 95% confidence level and a source population of 654 persons, we estimated a sample size of 123 participants for the survey (OpenEpi software version 3.1.). We estimated a response rate of 90%, as the field teams that were engaged in the malaria control activities had built a relationship of trust with the migrant community over the years and anticipated a relocation of 30% of migrants to outside the area at the time of the survey due to the high mobility of this population. We therefore selected 206 individuals to participate in the survey.

Data collection

We interviewed participants face-to-face using a structured questionnaire, which was available in Greek and English and was verbally translated into Urdu, the mother tongue of almost all the participants. It collected information on socio-demographic characteristics, malaria knowledge and attitudes, use of MPPs (e.g. topical insect repellent, bednets, coils) since 1 May 2013 (i.e. the month preceding the survey), health-care-seeking behaviour and access to healthcare. All bednets distributed to the migrants were LLINs, but in the interviews, the term ‘bednet’ was used, for simplicity. Participants provided non-prompted multiple answers for malaria knowledge to minimise any bias from leading questions.

Study teams also observed the conditions of the participants’ residences using a checklist that addressed the residence characteristics (e.g. house type, surrounding vegetation, water sources) and house-proofing measures such as mosquito screens. Fieldworkers and two interpreters, recruited and trained locally, interviewed participants. We piloted the questionnaire in Greek and Urdu in a village not participating in the study.

Ethics

We collected all information in an anonymous format and analysed aggregated data to ensure confidentiality. All participants in the survey provided informed verbal consent and received an HCDCP malaria information leaflet translated into their native language. The Ethics Committee of the National School of Public Health in Athens approved the survey.

Data analysis

We considered makeshift shelters, warehouses, store-rooms, stables and shacks as residences not built for housing. We defined indoor insecticides as insecticide-containing mosquito vaporising mats, liquids and sprays. We considered a person’s knowledge as correct for the following topics: (i) ‘transmission’, if at least one correct malaria transmission mode was reported; (ii) ‘symptoms’, if fever was stated as one of the possible malaria symptoms; and (iii) ‘prevention’, if more

TABLE 3A

Malaria knowledge and mosquito protection practices since May 2013 among migrant study participants in Evrotas, Greece, June 2013 (n = 130)^a

Knowledge or practice		Number (%) ^b	95% CI
Knowledge			
Malaria transmission	Mosquitoes	107 (82)	75–88
	Blood transfusion	3 (2)	0–7
	Pregnant mother to child	0 (0)	0–3
	Don't know	20 (15)	10–23
	Incorrect transmission modes ^c	51 (39)	31–48
	≥ 1 correct transmission mode ^d	107 (82)	75–88
Malaria symptoms	Fever	56 (43)	34–52
	Headache	36 (28)	20–36
	Joint/body pain	25 (19)	13–27
	Chills	10 (8)	4–14
	Feeling unwell	7 (5)	2–11
	Dizziness	2 (2)	0–5
	Diarrhoea or vomiting	2 (2)	0–5
	Other (loss of appetite, cough, flu-like illness, skin rash)	6 (5)	2–10
	Don't know	66 (51)	42–60
Existence of malaria treatment	Yes	126 (97)	92–99
Malaria prevention	Bednets	53 (41)	32–50
	Full-length clothing	11 (8)	4–15
	Indoor insecticides ^e	30 (23)	16–31
	Mosquito coils	24 (18)	12–26
	Avoidance of mosquitoes	21 (16)	10–24
	Topical insect repellents	10 (8)	4–14
	IRS	4 (3)	1–8
	Cleanliness (personal and/or household)	60 (46)	37–55
	Taking malaria tablets	21 (16)	10–24
	Drainage of stagnant water	9 (7)	3–13
	Other (mosquito screens, fan, avoiding going out at night)	9 (7)	3–13
	Don't know	19 (15)	9–22
	> 1 correct malaria prevention methods ^f	43 (33)	25–42
Malaria knowledge score ^g	0	17 (13)	8–20
	1	44 (34)	26–43
	2	45 (35)	27–44
	3	24 (18)	12–26

CI: confidence interval; IRS: indoor residual spraying; MPPs: mosquito protection practices.

^a Unless otherwise specified.

^b Some percentages do not add up to 100 because of multiple responses.

^c Garbage, drinking dirty water, person-to-person, sharing food with a sick person, kissing, sex, hot climate, water with mosquitoes.

^d Mosquitoes, blood transfusion, pregnant mother to child.

^e Mosquito vaporising mats, liquid vaporisers, spraying solutions/aerosols.

^f Long-lasting insecticide-treated bednets, full-length clothing and/or topical insect repellents, mosquito vaporising mats/liquids and/or aerosol, mosquito coils, avoiding mosquitoes.

^g Range of malaria knowledge score: 0–3; one point was given to each of the following: ≥ 1 transmission mode, at least fever (± ≥ 1 other symptom) and ≥ 2 malaria prevention methods.

TABLE 3B

Malaria knowledge and mosquito protection practices since May 2013 among migrant study participants in Evrotas, Greece, June 2013 (n = 130)^a

Knowledge or practice		Number (%) ^b	95% CI
Practices (since 1 May 2013, i.e. the month preceding the survey)			
MPPs (used often) ^h	Bednets	111 (85)	78–91
	Fan (ceiling/standing fan) or air-conditioning in sleeping room	102 (78)	70–85
	Mosquito coils	99 (76)	68–83
	Indoor insecticides (n = 129) ^e	81 (63)	54–71
	Wore full-length clothing	65 (50)	41–59
	Mosquito screens in sleeping room	64 (49)	40–58
	Air-conditioning in sleeping room	5 (4)	1–9
	Applied topical insect repellents	4 (3)	1–8
	Avoided going out at dusk and/or night	102 (78)	70–85
	Emptied stagnant water from containers	102 (78)	70–85
	Slept outside (≥ once a week)	27 (21)	14–29
	Slept outside without a bednet (n = 27)	5 (19)	6–38
	Burned waste and/or dung	5 (4)	1–9
Personal MPPs ⁱ	Yes	67 (52)	43–60
Number of household MPPs ^j	> 1 MPP (n = 129)	108 (84)	76–90
Overall MPPs ^k	> 2 MPPs	95 (73)	65–80
IRS performed the previous year	No	18 (14)	8–21
	Yes	71 (55)	46–63
	Don't know	41 (32)	24–40
IRS should be performed next year	Yes	127 (98)	93–100

CI: confidence interval; IRS: indoor residual spraying; MPPs: mosquito protection practices.

^a Unless otherwise specified.

^b Some percentages do not add up to 100 because of multiple responses.

^c Garbage, drinking dirty water, person-to-person, sharing food with a sick person, kissing, sex, hot climate, water with mosquitoes.

^d Mosquitoes, blood transfusion, pregnant mother to child.

^e Mosquito vaporising mats, liquid vaporisers, spraying solutions/aerosols.

^f Long-lasting insecticide-treated bednets, full-length clothing and/or topical insect repellents, mosquito vaporising mats/liquids and/or aerosol, mosquito coils, avoiding mosquitoes.

^g Range of malaria knowledge score: 0–3; one point was given to each of the following: ≥ 1 transmission mode, at least fever (± ≥ 1 other symptom) and ≥ 2 malaria prevention methods.

^h The question had three possible answers: 'often', 'sometimes', 'rarely' (the exact frequencies were not specified in the question). We present here only the results of the 'often' response (we merged the 'sometimes' and 'rarely' responses to create a binary variable).

ⁱ Yes/No answer: full-length clothing or topical insect repellents.

^j Indoor insecticides, fan or air-conditioning, mosquito screens, mosquito coils.

^k Personal and household MPPs.

than one malaria prevention method was mentioned. The transmission, symptoms and prevention scores were combined, to create an overall malaria knowledge score (score range: 0–3). We considered MPPs as sufficient if participants used more than two MPPs. We did not include the use of bednets in the calculation of the total number of MPPs and subsequently in the regression analysis since comprehensive distribution of LLINs to all migrants took place two weeks before the survey [11]. Hence, their use did not reflect migrants' usual behaviour and could bias the results. We calculated proportions with 95% confidence intervals (CIs) for categorical variables. We estimated crude and adjusted prevalence ratios (PRs) with 95% CIs, using robust Poisson regression and allowed for clustering of participants sharing the same residency using

the `vce(cluster)` option in STATA. We performed the analysis using STATA 12 software (StataCorp, Texas, United States, United States).

Results

We invited 206 (31%) persons of the 654 eligible individuals to participate in the survey. Of these, 74 (36%) had relocated from Evrotas and were excluded. Of the remaining 132 individuals, 130 (98%) agreed to participate. Almost all interviews (n = 128) were conducted in Urdu.

Socio-demographic characteristics

The respondents were young (median: 26 years; range: 18–55), male (100%) and predominantly from Pakistan (n = 120; 92%). They had lived in Evrotas for a median

of 3.0 years (range: 0.3–16) (Table 1). A total of 62 (48%) resided in buildings not built for housing. A median of six (range: 1–25) people lived in the same household and a median of three (range: 1–12) individuals living in a residence shared the same room.

Malaria awareness and attitudes

Of 130 participants, 117 (90%) reported having heard about malaria in the past (Table 2) while 86 (66%) (95%CI: 57–74%) said they did not need any more information about malaria. Of 129 respondents, 79 (61%) were worried that they or family/household members might become seriously ill with malaria.

Of 130 participants, 107 (82%) identified mosquitoes as the main mode of malaria transmission (Table 3). However, 51 (39%) also named at least one incorrect mode. Of these, 40 believed malaria was transmitted through garbage. Participants older than 34 years (PR: 1.3; 95% CI: 1.1–1.6), with more than seven years of education (PR: 1.4; 95% CI: 1.0–1.9) and those who would seek medical treatment for fever ($> 38^{\circ}\text{C}$) from ACD teams (PR: 1.3; 95% CI: 1.1–1.5) were more likely to know about malaria transmission (Table 4).

Of all 130 respondents, 56 (43%) identified fever and 36 (28%) headache as symptoms of malaria. Participants with more than seven years of education were more aware of fever as a symptom of malaria (PR: 3.2; 95% CI: 1.2–9.0). A total of 43 (33%) knew at least two malaria prevention methods; 53 (41%) mentioned bed-nets, 30 (23%) indoor insecticides and 4 (3%) stated IRS as a malaria control method. However, 71 (55%) reported IRS in their residence the previous year and 127 (98%) mentioned it should be sprayed next year. Participants aged 25–34 years and those coming from Pakistan knew more about prevention methods (PR: 1.8; 95% CI: 1.0–3.2 and PR: 3.9; 95% CI: 1.1–14.5, respectively). However, as the majority of participants were from Pakistan, this PR must be interpreted with caution. Of 130 respondents, 126 (97%) were aware of the existence of malaria treatment.

Use of mosquito protection and control measures

Of all participants, 67 (52%) used either full-length clothing or topical insect repellent; 108/129 (84%) used at least two household MPPs and 95 (73%) used more than two of five overall MPPs (median: 3; range: 0–5) (Table 3). In the month preceding the survey, 111 (85%) participants used bednets for sleeping. Six participants reported not sleeping under a bednet the previous month: the reasons given were that they had not received one ($n=3$), heat ($n=1$), they preferred to use an electric fan instead ($n=1$) and they believed that bednets were not more beneficial than IRS ($n=1$). The most common MPPs were the presence of electric fan or air-conditioning in the room used for sleeping ($n=102$; 78%), mosquito coils ($n=99$; 76%) and indoor insecticides (81/129; 63%); 64/130 (49%) reported the

presence of mosquito screens in the room used for sleeping.

Participants who were more likely to use more than two MPPs included those who would seek fever ($> 38^{\circ}\text{C}$) treatment from ACD teams (PR: 1.3; 95% CI: 1.0–1.6) and those worried about becoming seriously ill with malaria (PR: 1.5; 95% CI: 1.1–2.0). Residents of buildings not built for housing were less likely to use more than two MPPs (PR: 0.8; 95% CI: 0.6–0.9) (Table 4).

Treatment seeking behaviour and access to healthcare

A total of 77 (59%) participants stated that in case of fever ($> 38^{\circ}\text{C}$) they would seek treatment from ACD teams, 28 (22%) would go to the regional hospital in Sparta and 11 (8%) would attend the local health centre; 121/125 (97%) would seek treatment within one day (Table 5).

During the year before the survey, 16 (12%) participants sought medical care in a healthcare facility, nine of whom reported facing difficulties in accessing healthcare. The reasons included long distance to travel, user fees for outpatient visits, language problems, long waiting times, unfriendly personnel or the consultation was refused because of lack of insurance or legal documentation.

Discussion

Our study of a group of migrant workers in an area of autochthonous transmission of malaria in southern Greece has shown that knowledge about malaria transmission was high. Use of mosquito control measures was higher in persons who had better housing conditions, those who had concerns about becoming ill with malaria and those who would seek treatment from ACD teams. We identified certain knowledge gaps and misconceptions about malaria among the migrants, especially recognition of malaria symptoms and prevention methods, indicating areas where health education activities might be improved. Although most of the migrants would seek fever ($> 38^{\circ}\text{C}$) treatment within 24 hours, access to local healthcare in Evrotas was a challenge for this population.

Despite extensive fever-screening activities in Evrotas since 2011, less than half of the respondents knew that fever was the main malaria symptom. Those who were aware of this had a higher level of education, a finding that is consistent with other studies [17–19]. The early recognition of malaria symptoms is key to early healthcare-seeking behaviour. It is possible that some migrants from Pakistan may have been confused by the use of the word ‘bukhar’ for fever, as in Urdu the same word is used for malaria (‘malaria bukhar’). Interchangeable use of the same word for fever and malaria in Africa has been described and poses challenges in the interpretation of the results of malaria knowledge studies [20,21]. The level of knowledge of malaria symptoms in Evrotas was similar to that in a

TABLE 4

Factors associated with malaria knowledge and mosquito protective methods among migrant study participants in Evrotas, Greece, June 2013 (n = 130)^a

Knowledge and mosquito protective methods		Number/Total (%)	aPR ^b	95% CI
Knowledge of transmission: ≥ 1 mode ^c				
Age group in years	18–24	38/48 (79)	ref	–
	25–34	49/62 (79)	1.0	0.9–1.2
	≥ 35	20/20 (100)	1.3	1.1–1.6
Length of education in years	0	11/18 (61)	ref	–
	1–6	42/52 (81)	1.3	0.9–1.9
	7–12	54/60 (90)	1.4	1.0–2.0
Seeking fever (>38 °C) treatment from ACD teams	No	37/53 (70)	ref	–
	Yes	70/77 (91)	1.3	1.1–1.5
Knowledge of symptoms: fever				
Length of education in years	0	3/18 (17)	ref	–
	1–6	20/52 (38)	2.3	0.8–6.5
	7–12	33/60 (55)	3.2	1.2–9.0
Malaria in country of origin	Yes/Don't know	45/114 (39)	ref	–
	No	11/16 (69)	1.7	1.1–2.5
Knowledge of malaria prevention: > 1 method ^d				
Age group in years	18–24	10/48 (21)	ref	–
	25–34	24/62 (39)	1.8	1.0–3.2
	≥ 35	9/20 (45)	1.5	0.7–3.1
Country of origin	Other ^e	1/10 (10)	ref	–
	Pakistan	42/120 (35)	3.9	1.1–14.5
Length of education in years	0	5/18 (28)	ref	–
	1–6	10/52 (19)	0.8	0.3–2.0
	7–12	28/60 (47)	1.7	0.8–3.7
Time lived in Evrotas in years	< 1	10/25 (40)	ref	–
	1–2	7/33 (21)	0.6	0.3–1.3
	3–5	15/56 (27)	0.6	0.3–1.0
	> 5	11/16 (69)	1.3	0.8–2.2
Mosquito protection practices: > 2 methods ^f (n = 129)				
Type of residence	House/flat	55/68 (81)	ref	–
	Warehouse/shack	40/62 (65)	0.8	0.6–0.9
Worried about becoming seriously ill (themselves or family/household member) with malaria	No	27/50 (54)	ref	–
	Yes	68/79 (86)	1.5	1.1–2.0
Seeking fever (>38 °C) treatment in ACD teams	No	31/53 (58)	ref	–
	Yes	64/77 (83)	1.3	1.0–1.6
Marital status	Single	70/99 (71)	ref	–
	Ever married	25/31 (81)	1.2	1.0–1.4

ACD: active case detection; aPR: adjusted prevalence ratio; CI: confidence interval; ref: reference value.

^a Unless otherwise specified.

^b Calculated using the vce(cluster) option in STATA to allow for clustering of participants sharing the same residence.

^c Mosquitoes, blood transfusion, pregnant mother to child.

^d Long-lasting insecticide-treated bednets, full-length clothing or topical insect repellents, mosquito vaporising mats/liquids and/or aerosol, mosquito coils, avoiding mosquitoes.

^e Afghanistan, Bangladesh, Morocco.

^f Full-length clothing or topical insect repellents, indoor insecticides (mosquito vaporising mats, liquid vaporisers, spraying solutions/aerosols), fan or air-conditioning, mosquito screens, mosquito coils.

TABLE 5

Treatment-seeking behaviour and access to healthcare among migrant study participants in Evrotas, Greece, June 2013 (n = 130)^a

Treatment-seeking behaviour and healthcare access	Number (%)	95% CI
Type of healthcare facility sought following onset of fever (>38 °C)		
ACD teams	77 (59)	50–68
Hospital	28 (22)	15–30
Health centre	11 (8)	4–15
Pharmacy	9 (7)	3–13
Other	5 (4)	1–9
Time to presentation at healthcare facility following onset of fever (>38 °C) (n = 125)		
1 day	121 (97)	92–99
>1 day	4 (3)	1–8
Usual mode of transportation to healthcare facility		
Private car ^b	54 (42)	33–51
Taxi	47 (36)	28–45
Public transport	17 (13)	8–20
On foot	8 (6)	3–12
Other	4 (3)	1–8
Sought medical care in the previous year (for any reason)		
Yes	16 (12)	7–19
Any previous perceived difficulty while seeking medical care (n = 16)		
Yes	9 (56)	30–80

ACD: active case detection; CI: confidence interval.

^a Unless otherwise specified.

^b Of a friend, colleague, employer.

survey conducted in 2009 among Cambodian migrants who had recently entered Thailand [22]. In contrast, higher awareness of the classical symptoms of malaria has been reported in populations in malaria-endemic areas, such as Bangladesh and Ethiopia [23,24]. The above suggests that continuous and long-term health education is required to raise the community's awareness about the clinical manifestations of the disease.

As in other studies in populations in malaria-prone areas [17,18,23,25], knowledge that mosquitoes transmit malaria was high among the participants, especially among those who were educated. In addition, awareness about malaria transmission was associated with older age and seeking treatment from the ACD teams, possibly reflecting better access to health education activities provided by those teams. However,

participants also had misconceptions about malaria transmission and prevention, including mentioning garbage or presence of dirty water. Knowledge of both correct and incorrect modes of malaria transmission has been widely reported in rural communities [18,23,24] and may influence the prevention activities that individuals choose, including non-beneficial practices, although our study findings cannot confirm this. Improving the community's understanding of malaria transmission can greatly contribute to targeted prevention and control efforts [17]. In Evrotas, the level of awareness of malaria prevention methods was associated with the country of origin. In these countries, vector control programmes may differ in type and coverage and may also target other vector-borne diseases, such as dengue [1,26]. Such differences may create confusion about diseases, vectors and protection methods in the migrant population. This may explain the low recognition of IRS as a malaria prevention method in our study, despite its high acceptance among this community.

Most participants were aware of the existence of malaria treatment. In addition, the most commonly mentioned sources of treatment were the ACD teams. This timely health-seeking behaviour may be attributed to the continuous door-to-door ACD activities and the use of a dedicated telephone line for queries, providing easier access to information and treatment. However, in Evrotas, only a small proportion would seek care at the public local health centre, which might suggest difficulties in accessing this particular healthcare facility. Given the difficult economic situation in Greece since 2010, the consequent budget cuts in healthcare and chronic insufficiencies in the system [27], this finding might also reflect limited coverage or provision of services in the centre, quality issues or general health inequities between the local and migrant population [28]. Strengthening services and improving accessibility for migrant workers to the only public local healthcare facility in the area may play an important role in early diagnosis and treatment.

Most participants reported adopting multiple mosquito protection measures, mainly bednets, coils and indoor insecticides. However, only a few reported that these measures can prevent malaria. This suggests that participants may have associated these measures with mosquito biting nuisance rather than malaria prevention and control. In addition, knowledge of malaria was not associated with MPPs in this study. This pattern was also reported in Bangladesh in 2011 [25]. In our study, ACD teams provided the bednets (LLINs), coils and indoor vaporising insecticides free of charge and monitored their use. This may explain the high acceptance and reported use of these measures in our study, although the use of bednets was later shown to decline over time, mainly due to heat and the use of electric fans in the room used for sleeping [11]. In addition, the distribution of free-of-charge LLINs by the ACD teams was an essential measure, as LLINs are not licenced

and therefore are not commercially available in Greece. Greek authorities need to make LLINs easily available, given that their use is one of the most effective measures against malaria [1,29] and is usually associated with a high financial burden [30,31] which hinders their use, especially among individuals of low socio-economic status [18,23].

Poor and inappropriate housing conditions were associated with insufficient MPPs in our study. Most residences were overcrowded, not designed for human housing and lacked window and door mosquito screens. Other studies have shown that in areas with low to moderate transmission, improved house design, including mosquito screens, decreases malaria vector and other mosquito densities and reduces malaria transmission, while crowding results in the opposite [32,33]. Moreover, mosquito screens for houses are a sustainable, long-lasting, relatively inexpensive and acceptable protection measure used by communities elsewhere, but also traditionally in Greece, although mainly to decrease mosquito nuisance [15,34,35].

Our study has a number of limitations. It focused only on the migrant community and did not assess malaria knowledge and prevention practices among the Greek residents, among whom locally acquired malaria cases occurred [12]. We considered the migrant community more vulnerable to malaria, because of their low socio-economic status, poor living conditions and limited access to healthcare. In addition, the study included only men: there were no women and children in the migrant population in Evrotas. Data quality may have been affected by some variability in verbal translation of the questionnaire or cross-cultural variability in the respondents' comprehension of the survey questions. Over-reporting of desirable MPPs may have occurred, as it was not possible to verify the practices through direct observation. Our study did not have enough power to detect reasons for the difficulty in accessing healthcare. Although we took into account clustering of participants sharing the same residence in the analysis, we could not capture the frequent movement of people between residences and therefore the variation in their MPP use and habits.

Despite extensive public health interventions, following the re-emergence of *P. vivax* malaria in Evrotas in 2009 [36], the level of malaria awareness among migrants in our study was suboptimal, access to the main local healthcare facility was limited and poor housing conditions hindered effective mosquito protection. We consider that the public health authorities need to continue and reinforce ACD, distribution of mosquito protection items and health education activities, tailored to the education level and culture of migrants, to achieve better awareness of malaria and protection against mosquitoes among this population. Furthermore, health authorities need to identify and overcome barriers to access to the local healthcare facility, to ensure early diagnosis and treatment of malaria.

To achieve effective mosquito protection, the housing conditions of migrants need to improve. Activities to improve housing of migrants, such as availability of residences built for housing or improvement of existing ones and installation of mosquito screens, with the involvement of Greek house-owners, could be incorporated into a comprehensive vector control programme in the area. Finally, a similar survey among the local Greek population may contribute to the design of evidence-based public health interventions and the expansion of effective malaria control activities to this population, leading to a comprehensive malaria control programme, in order to decrease the risk of emergence of new cases and the re-establishment of malaria in Greece.

The findings of our study might also be useful for other European national public health authorities due to the increased influx of migrants and refugees from malaria-endemic countries into Europe [37], where favourable ecological conditions for malaria transmission [4,5] and potential malaria vectors are present [38,39].

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Conflict of interest

IE participated in the field teams in 2012. MT was the coordinator of the HCDCP interventions. The other members of the study team declare no conflict of interest.

Authors' contributions

IE performed the data analysis and drafted the manuscript. IE and KD designed the study. IE, KD, AL and TP developed the questionnaire; IE and YT administered the questionnaires; IE and MT organised the field activities. All authors contributed to the development of the manuscript and approved the final version.

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