The burden, clinical outcomes, and risk factors pertaining to malaria and neglected tropical diseases in the migrant populations in the Middle East and North Africa: A systematic review and meta-analysis.

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Annex 1. Search strategy

Interface: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily Date of Search: February 27, 2023 Number of hits: 692 Comment: In Ovid, two or more words are automatically searched as phrases; i.e. no quotation marks are needed	Field labels • exp/ = exploded MeSH term • / = non exploded MeSH term • .ti,ab,kf. = title, abstract and author keywords • adjx = within x words, regardless of order • * = truncation of word for alternate endings

Database(s): **Ovid MEDLINE(R) ALL** 1946 to February 24, 2023
Search Strategy:

#	Searches	Results
1	exp Human Migration/	27722
2	exp "Emigrants and Immigrants"/	15372
3	"Transients and Migrants"/	14022
4	Refugees/	12903
5	Refugee Camps/	288
6	(alien* or asile or asylum* or (border* adj2 cross*) or (countr* adj3 origin*) or diaspora or displace? or displacement* or emigrant* or emigration or expat? or expatriate? or foreigner* or foreign-born* or foreign background* or foreign population* or immigrant* or immigration or migrant* or migration or naturalized citizen* or new* arriv* or newcomer* or new-comer* or nomad* or non-citizen* or nonnative* or non-native* or nonnational or non-national or nonresident or non-resident* or resettlement* or re-settlement* or refugee* or settler* or squatter* or undocumented worker*).ti,ab,kf.	573858
7	or/1-6	587633
8	exp Middle East/	159113
9	exp Africa, Northern/	41057
10	(Abu Dhabi or Ajman or Algeri* or Arab* or Bahrain* or Bahreiin* or Dubai or Egypt* or Emirat* or Fujairah or Gaza* or Golf* or Gulf* or Ifriqiya* or Irak* or Iraq* or Jorda* or Jumhuuriiya* or Koweit* or Kuwait* or Kuwayt* or Leban* or Liban* or Liby* or Lubnan* or Maghr* or Maroc* or Maser* or Masr or Misr or MENA or Middle East* or Morocc* or North* Afric* or Oman* or Palestin* or Qatar* or Saudi* or Sharjah or Soudan* or Sudan* or Syria* or Syuri* or Tunis* or Uman* or Umm Al-Quwain or West Bank or Yemen*).ti,ab,kf.	318043
11	or/8-10	434382
12	Neglected Diseases/	2424
13	exp Malaria/ or exp Plasmodium/	90811
14	Buruli Ulcer/ or Mycobacterium ulcerans/	1098
15	exp Dengue/ or exp Arbovirus Infections/ or exp Flavivirus Infections/	52097
16	Chikungunya Fever/	2723
17	Dracunculiasis/	907
18	exp Echinococcosis/	20591
19	exp Trematode Infections/	37974
20	Trypanosomiasis, African/ or Trypanosomiasis/ or Euglenozoa Infections/	10112
21	exp Leishmaniasis/	25341
22	exp Leprosy/ or Mycobacterium leprae/	24706
23	Elephantiasis, Filarial/ or Wuchereria bancrofti/	4066
24	Mycetoma/ or exp Dermatomycoses/	29882
25	exp Onchocerciasis/ or exp Filariasis/ or Onchocerca volvulus/	16005
26	Rabies/ or exp Rhabdoviridae Infections/	13177
27	Scabies/ or exp Ectoparasitic Infestations/	22522
28	exp Schistosomiasis/	24882
29	exp Helminthiasis/	134192
30	Snake Bites/	5405

31	exp Taeniasis/ or exp Cestode Infections/ or exp Cysticercosis/ or Neurocysticercosis/	33945
32	Trachoma/ or exp Conjunctivitis, Bacterial/	6181
33	Treponemal Infections/ or Yaws/ or Treponema pallidum/	5990
34	(neglected adj3 disease*).ti,ab,kf.	8699
35	((arbovirus or echinococcus or euglenozoa or flavivirus or nematomorpha or rhabdoviridae or schistoma or trematode or treponemal) adj3 infection*).ti,ab,kf.	3845
36	(actinomycetoma or african sleeping sickness* or african trypanosomias?s or bacterial conjunctivitis or bancroftian elephantias?s or bancroftian filarias?s or bejel* or bilharsia* or bilharzias?s or black fever or borderline tuberculoid* or breakbone fever or break bone fever or buruli ulcer or chikungunya or coenuri* or coenuros?s or coenurus cerebralis or cysticercos?s or cysticercus cellulosae or deep mycos?s or dengue* or dermatomycos?s or dracuncul* or echinococcos?s or ectoparasitic infestation* or ectoparasitos?s or egyptian ophthalmia or eumycetoma or filarial elephantias?s or filariose or filiariasis or frambesia or guinea worm disease* or hansen* disease* or helminthias?s or hydatid cysts or hydatidos?s or hydrophobia or kalazar or kala azar or katayama fever or leishmani* or leprae or leepre or leprosies or leprosy or lymphatic filarias?s or lyssa or lyssas or madura foot or maduromycosis or malare or malaria or malayi elephantias?s or malayi filarias?s or myceetome or mycetoma or mycobacterium ulcerans or nagana or neurocysticercos?s or neuroschistosomias?s or onchocercias?s or onchocerca volvulus or onchocercose or oriental sore or plasmodium falciparum or paludisme or rabies or raby or river blindness or sarcoptic mange or scabies or schistosomias?s or schistosomal myel* or snakebite* or snake bite* or snake envenoming or taenia* or taenias?s or teeniase or trachoma* or treponema pallidum or treponematos?s or trypanosomiase or trypanosoma or trypanosomiasis or ulceere or ulcer disease* or wuchereria bancrofti or yaw or yaws or zazzabin cizon sauro).ti,ab,kf.	350022
37	or/12-36	543044
38	7 and 11 and 37	1064
39	(animals not humans).sh.	5062487
40	38 not 39	967
41	limit 40 to yr="2000 -Current"	692

Annex 2: Variables reported in the data extraction forms

Study details

1. First author surname or name of organisation
2. Year of publication
3. Country
4. Number of centres
5. Study design
6. Study setting
7. Total study duration
8. Funding
9. Aim of study
10. Disease (for those who have multiple diseases under consideration)

Methods details

11. Recruitment dates
12. General definition of sample
13. Participant inclusion criteria
14. Participant exclusion criteria
15. Definition of participants and comparator groups
16. Sample size at baseline for each participant group and total in the study
17. Sample size analysed for each participant group and total in the study
18. Numbers lost to follow-up/withdrawals for each participant group and total in the study
19. Follow-up duration (where appropriate)
20. Intervention and details for this
21. Baseline characteristics for each participant group and total in the study
    a. Age (as reported: mean, median, range, standard deviation, or frequencies and % in age categories)
    b. Female (frequency, %)
    c. Country of birth (frequency, %)
    d. Migrant type for migrant groups (all migrants, refugees, asylum seekers, labour migrants, internally displaced people, etc. and frequency/% of each as appropriate)
    e. Time in host country for migrant groups (as reported: mean, median, range, standard deviation, or frequencies and % if in categories)
    f. Living situation (frequency/% in camp setting, community, etc.)
    g. Occupation (frequency/%/% of each)
    h. Socioeconomic status (as reported)
    i. Co-morbidities
    j. Treatments
    k. Others
22. Outcomes and the definitions for each outcome

Results by each outcome

Indicators (e.g., incidence, mortality, coverage, uptake)

23. Number/mean reported with outcome in each participant and comparator group
24. Number/mean reported without outcome in each participant and comparator group
25. Totals / mean in each group and with and without outcome
26. Statistical parameter reported, e.g., odds ratio, risk ratio, mean difference and 95% CI and/or p value
    a. Crude (no adjustment) result reported
    b. Adjusted result reported
    c. Covariates adjusted for

(All the above in the results section should be repeated for each outcome of relevance reported in a study, as necessary)

Facilitators and barriers

27. List of barriers
28. List of facilitators
29. Other

Conclusions

30. Author's conclusions
31. Reviewer's notes

Annex 3. General characteristics included studies on neglected tropical diseases and malaria

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
Neglected Tropical Diseases									
Soil-transmitted helminthic infection									
Abu-Madi[53] 2010	2005-2008	Qatar	HMC hospitals	Microscopic stool examination	Patients attending the hospital	Long-term migrants: 5898 Qatari citizens: 3310	Any	3881 (42.1)	Prevalence Risk factors
Abu-Madi[57] 2011	2008	Qatar	HMC medical commission	Microscopic stool examination	Screened cases	Newly arrived migrants: 766 Resident migrant workers: 772	18-52	532(34.5)	Prevalence Risk factors
Abu-Madi[54] 2013	2005-2011	Qatar	HMC hospitals	Microscopic stool examination	Screened cases	Long-term migrants: 12,150 Qatari: 6413	Any	7772 (41.8)	Prevalence Risk factors
Abu-Madi[55] 2016	2005-2014	Qatar	HMC hospitals	Microscopic stool examination	Screened cases	Long-term migrants: 19,929 Qatari 9357	Any	12,295(41.9)	Prevalence Risk factors
Abu-Madi[56] 2016	2012-2014	Qatar	Medical commission	Microscopic stool examination	Screened cases	Newly arrived migrant: 2486	16-58	1351 (54.3)	Prevalence Risk factors
Dafalla[58] 2017	Jan-Dec 2013	UAE	Municipality public health clinic	Microscopic stool examination	Screened cases	Migrants: 21,347	≥16	3202 (15.0)	Prevalence
Imam[59] 2015	Two months	Saudi Arabi	Medical check-up & report center	Microscopic stool examination	Screened cases	Non-nationals migrant: 120	20-55	63(52.5)	Prevalence
Schistosomiasis									
Abu-Madi[57] 2011	2008	Qatar	HMC medical commission	Microscopic stool examination	Screened cases	Newly arrived migrants: 766 Resident workers: 772	18-52	532 (34.5)	Prevalence

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
Al-Awadhi[66] 2021	Jan 2010 Dec 2018	Kuwait	Reference national laboratory	Serological screening and Microscopic stool examination	Suspected cases	Migrants: 916 Kuwaiti citizens: 61	1-84	474 (47.8)	Confirmed cases (%) Risk factors
Balahbib[68] 2020	2005-2017	Morocco	Epidemiology directorate	NR	Reported cases	Migrants: 27	8-52	2 (7.4)	Distribution of cases by migration
Imam[59] 2015	Two months	Saudi Arabia	Medical check-up & report center	Microscopic stool examination	Screened cases	Migrants: 120	63 (52.5)	63 (52.5)	Prevalence
Mohammed[67] 2014	Jan 2012-Dec 2013	Saudi Arabia	Albaha PHC centers	Microscopic stool examination	Suspected cases	Migrants: 1891 Saudi nationals 232,364	Any	125,445(54.0)	Confirmed cases (%)
Teniasis									
Abu-Madi[57] 2011	2008	Qatar	HMC Medical Commission	Microscopic stool examination	Screened cases	Newly arrived. migrant 766; Resident workers 772	18-52years	532 (34.5)	Prevalence
Abu-Madi[56] 2016	2012–2014	Qatar	Medical Commission	Microscopic stool examination	Screened cases	Newly arrived migrants 2486	16-58 year	1351 (54.3)	Prevalence
Al-Awadhi[77] 2019	2015 -2017	Kuwait	Community-based	Stool Microscopic, Blood: ELISA	Screened	Migrant 1000	21 to 65 years	500 (50)	Prevalence Risk factors
Dafalla[58] 2017	Jan – Dec 2013	United Arab Emirates	Sharjah Municipality Microscopic Public Health Clinic	Microscopic stool examination	Screened cases	Migrants 21,347	≥ 16 years	3,202 (15)	Prevalence
Haddad[78] 2023	2013-2018	Qatar	Hamad Medical Corporation	Radiographic image, histology EEG	Reported cases	Migrants 415 (98.8) National 5 (1.2)	Any age	27 (6.4)	Confirmed cases of neurocysticercosis (%)
Hassan[60]	Aug 2016-	Iraq	Refugee camp	Microscopic	Suspected	IDPs 3925	8month -60	NR	Confirmed cases of

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
2020	May 2017			stool examination	cases		year		taenia (%)
Imam[59] 2015	Two months	Saudi Arabia	Medical Check-up & Report Center	Microscopic stool examination	Screened cases	Migrants 120	20-55 year	63 (52.5)	Prevalence
Cystic echinococcosis									
Al-Awadhi[66] 2021	Jan 2010 - Dec 2018	Kuwait	Ref. national laboratory	Serological screening	Suspected cases	Migrant 916 Kuwaiti 61	1-84 years	474 (47.8)	Confirmed cases (%) Risk factor
Filariasis									
Iqbal[79] 2006	Apr 2000 - Nov 2003	Kuwait	Ports and borders center, Ministry of Health	NFB microscopy ICT TropBio ELISA assay.	Screened cases	Migrant worker 1050	14-61 years	447 (42.6)	Prevalence
Cutaneous leishmaniasis (CL)									
Cross-sectional study									
Abdulla[46] 2018	January - December 2016	Iraq	Ebril Preventive health directorate	Clinical	Reported cases	IDPs: 49 (20.9) Refugees: 18(7.7) Residents: 167 (71.4)	Any age	83 (35.5)	Distribution of migrants among confirmed cutaneous leishmaniasis
Abdalla[42] 2019	Mar2010-Sep2011	Saudi Arabia	Almadina Surveillance system	Microscopically	Reported cases	Non-national: 132 (80.5) National: 32 (19.5)	Any age	0	Distribution of migrants among confirmed cutaneous leishmaniasis
Alawieh[47] 2014	Jan 2001 - Mar 2014	Lebanon	Surveillance system	Positive smear or culture.	Reported cases	Syrian refugee: 1206 (96.5) Nationals / Palestinian refugees: 44 (3.5)	Any age	527 (51)	Distribution of migrants among confirmed cutaneous leishmaniasis
Alhawarat[44] 2020 Amr[45] 2018	2010-2016 (2012-2016) [1]	Jordon	Surveillance system	Positive smear or culture	Reported cases	Syrian refugee: 559 (45.0) Nationals: 646 (52.0)	Any age	489 (39.3)	Distribution of cases by migration

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
Alraey[43] 2022	Jan - Dec 2021	Saudi Arabia	Asir Surveillance system	Microscopic PCR	Reported cases	Non-national: 18 (9.3); National: 176 (90.7)	Any age	73 (37.6)	Distribution of migrants among confirmed cutaneous leishmaniasis
Amin[41] 2013	2000-2010	Saudi Arabia	Al-Ahsa city, Surveillance system	NR	Reported cases	Non-national: 5393(54.1) National: 4569 (45.9)	3 months to 81 years	2172 (21.8)	Distribution of migrants among confirmed cutaneous leishmaniasis
Farah[50] 2023	2013-2019	Lebanon	Communicable disease surveillance Systems	NR	Confirmed cases	Syrian refugee 1683	Any age	NR	Incidence
Hassanein[51] 2022	January 2006 to December 2021	Saudi Arabia	Vector-borne Diseases Control Unit Tabuk	Microscopic	Reported cases	Migrant 739(46.9) Saudi national 836(53.1)	Any age	265(17)	Distribution of migrants among confirmed cutaneous leishmaniasis
Saroufim[48] 2014	Sep 2012	Lebanon	Refugee camp	Microscopic PCR	Suspected cases	Refugee 948	Any age	527 (51)	Confirmed cases (%)
Suliman[49] 2019	May 2013	Sudan	Village	Tissue smear Microscopy	Screened	IDPs 1236	Any age	688 (55.7)	Prevalence
Case-control study									
Lehlewa[52] 2021	NR	Iraq	Districts in Diyala Province (Al-Muqdadiya and Al-Mansuriya)	Clinical	Cases of CL and Control	Cases 432 (51%) Control 415(49%)	Any age	407 (48.2)	Risk factors
Dengue									
Ahmed[64] 2022	Aug 2015 - Feb 2016	Sudan	Refugee camp	RT-PCR	Suspected cases	IDPs 204	Any age	NR	Confirmed cases (%) Clinical outcomes
Alqassim[65] 2024	Jan 2015 Aug 2020	Saudi Arabia	Department of Health surveillance system- Jizan	PCR Serology	Reported cases	Migrant 910(26.6) Saudi 2517(73.4)	0-95 year	94 (35.2)	Incidence

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
Alshabi[62] 2019	2012-2020	Saudi Arabia	Hospital-based	Serologically PCR	Suspected cases	Migrant 1752 Saudi 4885	0-100 year	2471 (37.2)	Confirmed cases (%)
Farag[63] 2022	Jan 2013 - Dec 2021	Qatar	Surveillance &outbreak unit	PCR	Reported cases	Migrants 163(98) Qatari 2(2)	Any age	140 (24)	Reported cases
Humphrey[61] 2019	Jan 2013 - June 2016	Qatar	HMC (Blood bank)	ELISA	Screened cases	Migrants 1792 Qatari 200	>18 years	0	Prevalence Risk factors
Chikungunya									
Humphrey[61] 2019	Jan 2013 - Jun 2016	Qatar	HMC (Blood bank)	ELISA	Screened cases	Migrants 1792 Qatari 200	>18 years	0	Prevalence Risk factors
Scabies									
Abdullah[73] 2020	Jan -Aug 2019	Iraq	Dhkouk province health centre-IDP camp	Clinical Microscopically Dreamscape	Suspected cases	IDP 6264 residents 29,183	Any age	NR	Confirmed cases (%)
ALBERFKANI[74] 2020	Jan 2018 - Dec 2019	Iraq	Cham Mishiko city IDP camp	Microscope	Suspected cases	IDP 1300	>=1year	654 (50.30)	Confirmed cases (%)
Alsamara[72] 2017	Oct 2015 - Oct 2016	Iraq	Kirkuk city Dermatologic clinic	Clinical Microscopic	Reported cases	IDP 153	Any age	68 (44.4)	Distribution of cases by migration
Trachoma									
Javaloy[71] 2002	Oct 2001	Algeria	Refugee camp	Clinical examination	Screened cases	children aged 3-16) 527	3-16 year	274 (52)	Prevalence
Macleod[70] 2019	2014 - 2015	Sudan	IDPs Camps	clinical examination	Screened cases	IDPs Children 1823; adult 2139	Any age	2548 (56)	Prevalence
Sanders[69] 2019	NR	Sudan	Refugee camp	Clinical examination	Screened cases	South Sudanese refugee: Children 1601; Adult 1734	Any age	1986 (59.5)	Prevalence
Leprosy									
Al-Mutairi[75] 2010	Jan 2003 - Dec 2008	Kuwait	Farwaniya dermatology departments	The detection of lepra bacilli slit skin smear. nasal smears	Reported cases	Migrants 41(89.1) Kuwaiti 5(10.9)	Any age	8 (17.4)	Distribution of cases by migration

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
Assiri[76] 2014	2003 - 2010	Saudi Arabia	Surveillance system	WHO criteria	Reported cases	Migrants 39(57.4) Saudi 139(42.6)	15-44	Total 103(42.5)	Distribution of cases by migration
Malaria									
Abdalal[28] 2023	2015-2018	Saudi Arabia	Jizan Aledabi and Baish centre	Malaria rapid diagnostic test or microscopy	Reported cases	Non-Saudi 2407 Saudi: 803 Cross border	IQR 25	324 (10)	Distribution of cases by migration Risk factors
AlKuwari[27] 2009	2004 - 2006.	Qatar	Surveillance system	NR	Reported cases	Migrant 434(99.1) Qatari 4 (0.9)	Any age	70(16)	Distribution of cases by migration Risk factors
AlRumhi[25] 2020	2013 - 2016	Qatar	HMC hospital	Microscopic	Suspected	Migrants 583	NR	NR	Confirmed cases (%) Risk factors
Anderson[36] 2011	Jan 2006 - Dec 2009	Sudan	UNHCR database	RDT or Microscopy	Reported cases	NR	Any age	NR	Clinical outcomes
Elguarisha[29] 2019	Sep 2014- Nov 2017	Sudan	Hospitals and health centers in 10 states	Microscopy	Suspected cases	Refugees: 384 Residents: 842	0-85	40	Confirmed cases (%) Risk factors
EL-MALKY[37] 2016	2014 -2015	Saudi Arabia	Centre of Malaria Elimination program	Microscopy	Reported cases	Migrant 232 (98.7) Saudi 3 (1.3)	>= year	89(38)	Distribution cases by migration Risk factors
ElMekki[30] 2012	Nov 2008 Feb 2009	Sudan	Khartoum Refugee camp	Microscopic	Suspected	IDPs 300	Any age	NR	Confirmed cases (%) Clinical outcomes
Eshaq[38] 2020	Jul 2018 - Dec 2018	Sudan	AlGeneina Ardamata IDP camp.	nPCR	Suspected	IDPs 365 Visitor 15	1 to 80 years	222(58.4)	Confirmed cases (%)
Farag[32] 2018	Jan 2008 - Dec 2015	Qatar	Surveillance System	Microscopic	Suspected	Migrants 4078 (99.6); Qatari 14 (0.4)	Any age	284 (7)	Distribution of cases by migration
Hawash[35] 2019	Aug 2016- Sep 2018	Saudia Arabia	Tertiary care hospital	PCR	Suspected	Migrants 134 Saudi 141	>= 5 years	165 (60)	Confirmed cases (%) Risk factors
Iqbal[26] 2020	Jan 2013 – Dec 2018	Kuwait	Infectious Diseases Hospital	Rapid diagnostic test	Reported cases	Migrant 1895(99) Kuwaiti 18 (1)	1 to 73 years	NR	Distribution of cases by migration

Study	Study period	Study country	Study setting	Diagnostic method	Study population	Sample size	Age inclusion criteria	Female (%)	Outcome(s)
Khan[39] 2006	2000-2002	Qatar	HMC Hospital	Microscopic	Reported cases	Migrant 147 (96) Qatari 6 (4)	Any age	35(22.9)	Distribution of cases by migration Risk factors
Khan[34] 2009	Jan 2005 – Jun 2005	Qatar	HMC hospital	Microscopy	Reported cases	Migrant 77 (95) Qatari 4 (5)	Any age	17(21)	Distribution of cases by migration Clinical outcomes
Memish[40] 2014	2008 -2011	Saudi Arabia	Makkah: 19 sentinel sites	NR	Reported cases	Migrant 302(95) Saudi 16(5)	Any age	NR	Distribution cases by migration
Nilles[33] 2014	Jan 2008 - Dec 2010	Dubai Emirate	599-bed Rashid Hospital and Trauma Center	NR	Reported cases	Migrant 629(100)	Any age	44(7)	Distribution of cases by migration Risk factors Clinical outcomes
Saeed[31] 2003	No 2001 – Dec 2002.	Sudan	Khartoum IDPs camp	NR	Suspected	IDPs 856	Any age	734(85.7)	Incidence Risk factors

Note: All studies are cross-sectional unless stated otherwise in the table. [1] Two studies in the same population. Abbreviations: HMC: Hamad Medical Corporation, UAE: United Arab Emirates, NR: Non-reported, PCR: polymerase chain reaction, nPCR: Nested polymerase chain reaction, IDP: Internally displaced persons, ICT: Immunochromatographic Test, ELISA: Enzyme-linked Immunosorbent Assay, UNHCR: United Nations High Commissioner for Refugees, RT-PCR: Reverse Transcriptase Polymerase Chain Reaction

Annex 4. Risk factors for malaria and NTDs among migrants in the Middle East and North Africa

Author, year country	Study design Setting	Participants	Outcome	Risk factor	Statistical measures			Covariates adjusted for
					x^2 (p-value)	Odd ratio (95% CI)Are all ORs or are some RRs?	Adjusted odds ratio (95% CI)	
Elguarisha[32] 2019 Sudan	Cross-sectional Hospitals and health centres covering 21 sites in 10 states	Residents in all states:157(77.3) Ethiopian refugees:23 (12.7)	P. vivax infection	Residency status	31.13 (p=0.000)			
Eshaq[41] 2020 Sudan	Cross-sectional Darfur Ardamata IDP camp	IDPs: 380 {suspected}	Positive malaria infection	Test positivity for malaria Sex Male Female	p=0.042	 1.55 (1.02-2.38) 1		
				Residence Resident Visitor	p=0.932	 1.047 (0.37, 3.00) 1		
				Age group ≤ 20 years ≥ 21 years	P= 0.579	 1 0.89 (0.58, 1.35		
				Occupation None (student and retired) self-employ Government	 P =0.445 P =0.837	 1 1.19 (0.75, 1.88) 0.89 (0.30, 2.65)		
				Monthly income <$20 $20-25 $25-30 >$30	 P= 0.204 P =0.764 P = 0.182	 1 0.66 (0.35, 1.25) 1.12 (0.53, 2.36) 0.61 (0.29, 1.26)		
				Marital status Married Single	 P = 0.871	 1 0.97 (0.64,1.47)		
				Education level Illiterate Primary school Secondary school Graduate	 P= 0 .513 P= 0.806 P= 0.855	 1 0.86 (0.54, 1.37) 0.92 (0.49, 1.730 1.10 (0.41, 2.93)		
				Joint pain No Yes	 P = 0.201	 1 1 .752		
				Fever No Yes	 P= 0.562	 1 1.170		
Hawash[38] 2019 Saudia Arabia	Cross-sectional A tertiary care hospital	Migrant 19 (63.3) Saudi 11 (36.7) {suspected}	PCR-confirmed malaria	Nationality	P = 0.0899			
Nilles[36]	Cross-sectional	Migrant 629(100)	*Plasmodium* species detected?	The interval between	P = 0.084			

Author, year country	Study design Setting	Participants	Outcome	Risk factor	Statistical measures			Covariates adjusted for
					x^2 (p-value)	Odd ratio (95% CI)Are all ORs or are some RRs?	Adjusted odds ratio (95% CI)	
2023Emirates	599-bed Rashid Hospital and Trauma Center			symptom onset - lab diagnosis (days) (median // IQR)				
				The interval between arrival in the UAE and diagnosis (weeks) (median // IQR)	P = 0.059			
				Symptoms of malaria (%)	P >.05			
				Clinical outcome of Hospitalized all Malaria cases (%Hospitalized ICU Death	 p = 0.000 p = .005 p =0.216	,		
				Length of stay (mean)	P = 0.029			
Khan[37] 2009 Qatar	Cross-sectional surveillance system	Migrant 434 (99.1) Qatari 4 (0.9%)	Distribution of Plasmodium species among different groups of malaria cases (Qatari, non-Qatari resident migrants, Newley arrived migrants /short-term visitors)	Country of travel	p < 0.001			
			Birthplace Qatar (Sudan, Pakistan, India, Nepal, Sri Lanka, China, Bangladesh)	 p <.001 n.s				
			Plasmodium species *P.vivax* *P.falciprum*	 n.s n.s				
			Age by classes 0-10 11-20 21-30 31-40 41-50 51-60 >60	 p =0.003 n.s p<0.01 n.s p<0.01 n.s n.s				
		Severe falciparum malaria cases N (%	Nationality	P = 0.02				

Author, year country	Study design Setting	Participants	Outcome	Risk factor	Statistical measures			Covariates adjusted for
					x^2 (p-value)	Odd ratio (95% CI)Are all ORs or are some RRs?	Adjusted odds ratio (95% CI)	
		Imported malaria cases percentage between Qatri and non-Qatari	Acquire of infection Saudi Arabia (Pakistan, India Sudan, Nepal Sri Lanka, China Bangladesh	P = 0.04 n.s				
Saeed[34] 2003 Khartoum Sudan	Cross-sectional refugee camp	IDPs 856 Suspected	Malaria attacks during the past year	Area	6.2 (0.01)	1.5 (1.08–2.08)	4.07 (2.49–6.65)	
				Age > 60 < 21 21–40 41–60	7.2 (p=0.07)	 1.4 (0.46–4.3) 1.5 (0.5–4.5) 2.7 (0.86–8.6)	 1.49 (0.45–4.95) 2.08 (0.67–6.45) 3.93 (1.17–13.18)	
				Sex	0.2 (p=0.60)	1.10 (0.73–1.65)	1.38 (0.84–2.25)	
				Language Local + Arabic Arabic Dinka only	29.2 (p< 0.001)	 1.5 (0.8–2.7) 3.4 (2.1–5.4)	 1.60 (0.84–3.07) 2.71 (1.43–5.13)	
				Education Basic Secondary /higher Illiterate	14.2 (p=0.001)	 0.6 (0.47–0.88) 2.5 (1.45–4.3)	 1.71 (0.93–3.13) 1.36 (0.94–1.95)	
				Housing conditions Acceptable Poor	2.3 (p=0.13)	1.33 (0.92–1.92)	1.15 (0.83–1.59)	
				Food expenditure 33% income 25% income 50% income All income No income	11.1 (p=0.03)	 Ref 1.14 (0.4–3.14) 2.0 (1.15–3.6) 2.2 (1.3–3.7) 2.3 (0.97–5.7)	 Ref 1.16(0.35–3.82) 2.11 (1.08–4.11) 1.97 (1.09–3.61) 1.57 (0.58–4.21)	
				Treatment-seeking behavior	0.06 (p=0.80)	0.96 (0.7–1.2)	1.10 (0.7–1.6)	
				Source of water	38.8 (p< 0.001)	2.58 (1.91–3.50)	4.67 (2.81–7.76)	
				Keeping water	0.002 (p=0.90)	0.98 (0.54–1.78)	1.61 (0.79–3.28)	
				Knowledge	0.28 (p=0.60)	1.08 (0.81–1.44)	1.12 (0.78–1.60)	
				Attitude and practices	0.26 (p=0.61)	1.08 (0.79–1.47)	0.93 (0.64–1.33)	
				Education level Primary school Secondary school /higher Illiterate	14.2 (0.001)	 0.6 (0.47–0.88) 2.5 (1.45–4.3)	 1.71 (0.93–3.13) 1.36 (0.94–1.95)	
Hookworm								

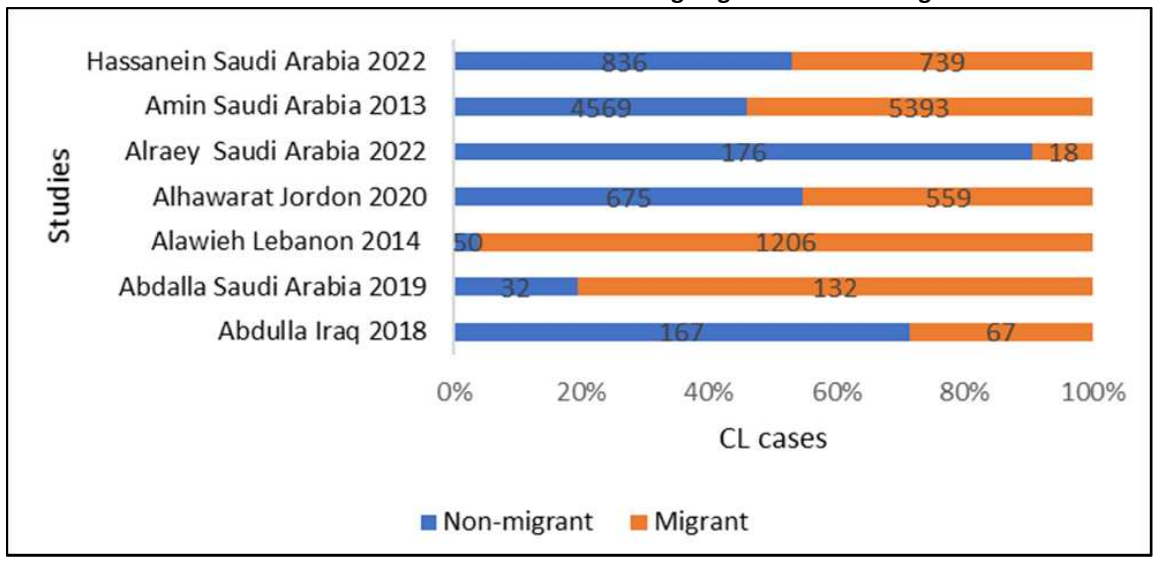
Author, year country	**Study design Setting**	**Participants**	**Outcome**	**Risk factor**	**Statistical measures**			**Covariates adjusted for**
					x^2 (p-value)	Odd ratio (95% CI)Are all ORs or are some RRs?	Adjusted odds ratio (95% CI)	
Abu-Madi[56] 2010 Qatar	Cross-sectional Hamad Medical Corporation	Long-term resident migrants 5898 Qatari 3310	Prevalence of infection	Region of origin	χ2 = 154.5 p < 0.001			
Abu-Madi[59]2016 Qatar	Cross-sectional Hamad Medical Corporation &Medical Commission	Newly arrived migrants n = 2,486	Prevalence of infection	Sex	χ2 1=4.56, p= 0.033			
				Sex	n.s			Age and region
				Region of origin	χ2 = 10.5 P = 0.015			
				Age	X2 3 =11.2. p= 0.011			
				Temporal effect (year)	n.s			
			Abundance of infection (egg count)	Sex	z = 2.142 P = 0.032			
				Region of origin	H3 = 11.497, P = 0.009			
				Age class	H3 = 13.3 P = 0.004			
				Temporal effect (year)	n.s			
Ascaris lumbricoides								
Abu-Madi 2013 Qatar	Cross-sectional HMC hospitals	Long-term resident migrants 12150 Qatari 6413	Prevalence of infection	Region of origin	χ2 = 67.5 P < 0.001			
Abu-Madi[59] 2016 Qatar	Cross-sectional Hamad Medical Corporation &Medical Commission	Newly arrived migrants n = 2,486	Prevalence of infection	Sex	n.s			
			Abundance of infection (egg count)	Region of origin	χ2 = 2.86 p = 0.413			
				Age class	χ2 = 2.6 p = 0.455			
				Temporal effect (year)	χ2 2 = 12.1 p = 0.002			Sex and age
				Region of origin	n.s			
				Age class	n.s			
				Sex	n.s			
				Temporal effect (year)	H= 9.584, p=0.008			
Trichuris trichuria								
Abu-Madi[56] 2010 Qatar	Cross-sectional HMC	Long-term resident migrants 5898 Qatari 3310	Positive rate of infection	Region of origin	χ2 = 62.0, p < 0.001			
Abu-Madi[57] 2013; Qatar	Cross-sectional HMC hospitals	Long-term resident migrants 12150; Qatari 6413	Positive rate of Infection	Region of origin	χ2 = 112.3 p < 0.001			
Abu-Madi[59] 2016 Qatar	Cross-sectional Hamad Medical Corporation &Medical Commission	Newly arrived migrants n = 2,486	Prevalence of infection	Sex	n.s			
				Region of origin	χ2 = 2.23, p = 0.526			

Author, year country	Study design Setting	Participants	Outcome	Risk factor	Statistical measures			Covariates adjusted for
					x^2 (p-value)	Odd ratio (95% CI)Are all ORs or are some RRs?	Adjusted odds ratio (95% CI)	
				Age class	$\chi2 = 3.86$, p= 0.277			
				Temporal effect (year)	n.s			
			Abundance of infection (egg count)	Temporal effect (year)	n.s			
				Region of origin	n.s			
				Sex	n.s			
				Age class	n.s			
Humphrey[64] 2019 Qatar	Cross-sectional Blood bank	Migrants 1792 Qatari 200	Anti-DENV IgG seropositivity among blood donors residing in Qatar but from a different region	Region of origin Asia Middle East North Africa Qatar	 Ref p<0.001 p<0.001 p<0.001	 Ref 0.05 (0.03–0.06) 0.14 (0.10–0.20) 0.01 (0.01–0.03)	 Ref 0.05 (0.04–0.07) 0.14 (0.10–0.20) 0.01 (0.01–0.03)	The setting of anti-CHIKV IgG positivity
			Age-specific anti-DENV IgG seroprevalence among blood donors	<24 25–29 30–34 35–39 40–44 45–49 >50	Ref P= 0.035 P= 0.006 P= 0.006 P= 0.008 P= 0.021 P= 0.001	Ref 2.51 (1.44–4.36) 2.98 (1.74–5.08) 2.58 (1.50–4.43) 2.30 (1.32–4.01) 2.87 (1.60–5.16) 2.48 (1.37–4.50)	 1.20 (1.05–3.79) 2.38 (1.28–4.41) 2.42 (1.30–4.51) 2.40 (1.25–4.56) 2.26 (1.13–4.50) 3.18 (1.61–6.28)	The setting of anti-CHIKV IgG positivity
			Anti-CHEK IgG seropositivity among blood donors residing in Qatar but from different regions.	Region of origin Asia Middle East North Africa Qatar	 Ref p<0.001 p=0.038 p=0.041	 Ref 0.09 (0.05–0.16) 0.37 (0.20–0.67) 0.23 (0.10–0.53)	 Ref 0.14 (0.07–0.27) 0.50 (0.26–0.96) 0.38 (0.15–0.96)	The setting of anti-DENV IgG positivity
			Age-specific anti-CHIKV IgG seroprevalence among blood donors	<24 25–29 30–34 35–39 40–44 45–49 >50	Ref P= 0.721 P= 0.721 P= 0.541 P= 0.551 P= 0.406 P= 0.704	 1.95 (0.64–5.97) 1.95 (0.66–5.80) 1.02 (0.31–3.29) 1.84 (0.60–5.70) 2.62 (0.83–8.28) 1.51 (0.43–5.25)	Ref 1.23 (0.39–3.89) 1.21 (0.40–3.70) 0.69 (0.21–2.29) 1.42 (0.45–4.52) 1.65 (0.51–5.42) 1.28 (0.36–4.59)	The setting of anti-DENV IgG positivity
schistosomiasis								
Al-Awadhi[69] 2021 Kuwait	Reference national lab	Migrant 916 Kuwaiti 61	Positive rate of schistosomiasis	Country of origin Kuwait & other countries	p<0.001			
cutaneous leishmaniasis								
Lehlewa[55] 2021 Iraq	Districts in Diyala Province (Al-Muqdadiya and Al-Mansuriya)	Cases 432 (51%) Control 415(49%)	Odds of contracting CL	Displacement	p<0.001			
cystic echinococcosis								

Author, year country	**Study design Setting**	**Participants**	**Outcome**	**Risk factor**	**Statistical measures**			**Covariates adjusted for**
					x^2 (p-value)	Odd ratio (95% CI)Are all ORs or are some RRs?	Adjusted odds ratio (95% CI)	
Al-Awadhi[69] 2021 Kuwait	Reference national lab	Migrants 568 Kuwaiti 423	Positive rate of cystic echinococcosis	Country of origin Kuwait & other countries	p<0.001			
Cysticercosis								
AAwadhi[80] 2019 Kuwait	Community-based	Migrant 1000	Prevalence of cysticercosis among the migrant workers	Gender	p = 0.431			
				Hand-washing frequency	p = 0.203			
				Social status (income)	p = 0.129			

Abbreviations: ns: Not significant p >0.05, UAE: United Arab Emirates, HMC: Hamad Medical Corporation, Ref: Reference, OR: Odds Ratio, PCR: polymerase chain reaction, IDP: Internally displaced persons, IQR: Interquartile Range, ICU: Intensive Care Unit, Anti-CHIKV IgG: anti-dengue (DENV) antibodies, anti-DENV IgG: anti-chikungunya (CHIKV) antibodies, CL: Cutaneous leishmaniasis, p.vivx: *Plasmodium vi*

Annex 5. Distribution of cutaneous leishmaniasis cases among migrants and non-migrants in the MENA region



Abbreviation: CL: Cutaneous leishmaniasis

Annex 6. Distribution of malaria cases among migrants and non-migrants in the MENA region