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Original Article

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Health problems and exposure to infectious risks in returning humanitarian aid workers

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Abstract

Background: Humanitarian aid workers are exposed to deployment-related health threats. Identifying subgroups at a higher risk of infection in this diverse population could help optimize prevention.

Methods: We carried out a retrospective study based on anonymized data of humanitarian aid workers that visited our clinic for a post-deployment visit between 1 January 2018 and 31 December 2021. We conducted a descriptive analysis of basic demographic data, self-reported risk exposure and health problems encountered during deployment extracted from a standard questionnaire.

Results: The questionnaire was administered to 1238 aid workers during 1529 post-deployment medical consultations. The median age was 37.2 years (IQR 31.7–44.3), and 718/1529 (47.0%) were female aid workers. The median duration of deployment was 6 months (IQR 3–12 months). Most deployments (1321/1529 (86.4%)) were for a medical organization and in Sub-Saharan Africa (73.2%). The most common risk exposures were contact with freshwater in schistosomiasis endemic regions (187/1308 (14.3%)), unprotected sexual contact with a person other than a regular partner (138/1529 (9.0%)), suspected rabies exposure (56/1529 (3.7%)) and accidental exposure to blood (44/1529 (2.9%)). Gastrointestinal problems (487/1529 (31.9%)), malaria (237/1529 (15.5%)) and respiratory tract infections (94/1529 (6,2%)) were the most encountered health problems. Fifteen volunteers (1%) were hospitalized during deployment and 19 (1.2%) repatriated due to health problems. Adherence to malaria chemoprophylaxis was poor, only taken according to the prescription in 355 out of 1225 (29.0%) of aid workers for whom prophylaxis was indicated.

Conclusion: Humanitarian aid workers deployed abroad encounter significant rates of health problems and report a high level of risk exposure during their deployment, with the risks being greatest among younger people, those deployed to rural areas, and those working for non-medical organizations. These findings help guide future pre-deployment consultations, to increase awareness and reduce risk behaviour during deployment, as well as focus on adherence to medical advice such as malaria chemoprophylaxis.

Key words: Humanitarian aid workers, health problems, risk behaviours, schistosomiasis exposure, rabies exposure, malaria, diarrhoea

Introduction

Travelling abroad, especially to lower resource countries, is associated with a significant risk of encountering a health problem specific to the location of travel, such as gastrointestinal and respiratory tract infections, malaria, and accidents or injuries.[1–4] A special category of travellers is aid-workers who are deployed to areas affected by conflict, natural disaster or other circumstances compromising basic sanitary and living conditions.[5] They can be exposed to infectious diseases that other travellers do not encounter frequently, such as Lassa fever or Ebola,[6,7] as well as particular risks such as violence, accidents and post-traumatic stress disorder.[8] These risks are sometimes increased by specific behaviours and poor adherence to medical advice provided before deployment.[9] Previous studies found high rates of security incidents, increased risk in driving, increased unprotected sexual contacts and worsening of subjective health in humanitarian aid workers, but data in this subset remain poor.[9,10] Insights on risk behaviour, exposure to risk and health problems encountered could guide future consultations and training of humanitarian aid workers before deployment. In a retrospective analysis of data routinely collected at our travel clinic, we aim to summarize health problems and risks to which aid-workers are exposed, as well as identify risk factors for most common risk behaviours and health problems encountered during deployment.

Methods

Our travel clinic provides post-deployment consultations for humanitarian aid workers. They are seen upon return by a travel medicine specialist, who completes a standardized questionnaire during the medical visit. One questionnaire was filled per deployment (Supplementary Appendix A). We record data on the country, duration, zone (urban/rural/mixed), purpose of deployment and type of organization, as well as data on exposure to situations with a risk for infectious diseases or other health problems, such as bites, scratches and licking on wounds by animals with a potential to carry rabies, freshwater exposure in schistosomiasis endemic regions,[11] unprotected sexual contact and accidental exposure to blood. In addition, health problems encountered during deployment such as gastrointestinal disorders (diarrhoea, abdominal pain, nausea/vomiting), respiratory tract infections, malaria, hospitalizations or evacuations for medical reasons are collected. Finally, we record the need for malaria chemoprophylaxis in accordance with French guidelines,[12] and its compliance.

For this retrospective study, we analysed the anonymized data of humanitarian aid workers that visited our clinic for a post-deployment visit between 1 January 2018 and 31 December 2021. We conducted a descriptive analysis of basic demographic data, self-reported risk exposure and health problems encountered during deployment. Results are presented as absolute values, proportions, means (95% CI) or median (IQR), as appropriate. Factors associated with risk exposure and health problems were identified using logistic regression models. Significance was declared at $P < 0.05$. For malaria risk factors, a sensibility analysis has been performed excluding infection without RDT confirmation. All analyses were performed using Stata 16 (Stata Corp., College Station, TX, USA).

This study complies with the rules of French Data Protection Authority and the European General Data Protection Regulation.

Results

Demographics, deployment circumstances

A total of 1238 aid workers were seen during 1529 post-deployment medical consultations (Table 1). The median age was 37.2 years (IQR 31.7–44.3) and 718 out of 1529 (47.0%) deployments were carried out by women, whereas 597/1238 (48%) of the aid workers were women. The median duration of deployment was 6 months (IQR 3–12 months). Most aid workers (1321/1529 (86.4%)) were employees of a medical organization and were deployed in Sub-Saharan Africa (1119/1529 (73.2%)). Four hundred and sixty-three workers (42.5%) stayed in an urban setting, 214 (19.6%) in a rural setting, and 413 (37.9%) in both (data not available for 439 individuals). Regarding at risk areas, 1457 deployments were in malaria-endemic regions and 1308 in schistosomiasis endemic regions.

Self-reported risk exposure

During the 1529 deployments, 540 (35.3%) aid workers self-reported exposure to at least one risk (Table 2). The most common exposures were contact with freshwater in schistosomiasis endemic regions (187/1308 (14.3%)); unprotected sexual contacts with a person other than a regular partner (138/1529 (9.0%)); bites, scratches or licking of open wounds by animals with a potential to carry rabies (56/1529 (3.7%)); and accidental exposure to blood (44/1529 (2.9%)) (Table 2).

Health problems during deployment

Health problems were reported in 923 out of 1529 (60.4%) post-deployment medical consultations (Table 2). The most common health problems were gastrointestinal disorders (487/1529 (31.9%)) and malaria (237/1457 (16.3%)), of which 192 (81.0%) were diagnosed by a Rapid Diagnostic Test. Other health problems encountered during the deployment included respiratory tract infections (94/1529 (6.2%)), musculoskeletal problems (58/1529 (3.8%)) and dermatological problems (52/1529 (3.4%)). Musculoskeletal problems included trauma and injury (23/58 (39.6%)), back pain (23/58 (39.6%)) and neck pain (7/58 (12.1%)). Skin and soft tissue infections accounted for most dermatological problems (27/52 (51.9%)). In 15 out of 1529 (1.0%) deployments, aid workers were hospitalized during travel and evacuation for medical reasons was carried out in 19 out of 1529 (1.2%).

Risk factors for exposure to schistosomiasis, sexually transmitted diseases and rabies

In a multivariate analysis, an age between 18 and 30 years and a longer duration of deployment were associated with a higher risk of three types of exposures: freshwater exposure in

Table 1 Population description of aid-workers attending post-deployment medical consultations, $n = 1529$

Characteristics	Categories	*n* (%)
Sex	Male	811 (53.0%)
	Female	718 (47.0%)
Age (years, by category)	18–30	260 (17.0%)
	31–40	696 (45.5%)
	41–50	371 (24.3%)
	51–60	174 (11.4%)
	≥ 61	28 (1.8%)
Duration of deployment	≤ 1 month	154 (10.1%)
	>1–6 months	664 (43.4%)
	>6–12 months	448 (29.3%)
	>12 months	263 (17.2%)
Type of organization	Medical organization	1321(86.4%)
	Non-medical organization	204 (13.3%)
	No data available	4 (0.3%)
Region of deployment	Sub-Saharan Africa	1119 (73.2%)
	Middle-East	171 (11.2%)
	South Central Asia	81 (5.3%)
	South East-Asia	32 (2.1%)
	Caribbean	60 (3.9%)
	Oceania	23 (1.5%)
	North Africa	13 (0.9%)
	South America	10 (0.7%)
	Others and Multiple regions*	20 (1.3%)
Setting of deployment	Mix rural and urban	413 (27.0%)
	Predominantly urban	463 (30.3%)
	Predominantly rural	214 (14.0%)
	No data available	439 (28.7%)

*Others: Central America: 3; Eastern Europe: 2; Multiple regions: 15.

schistosomiasis endemic areas, unprotected sexual contact and exposure to rabies risk (Table 3). Female were found to have a higher risk for the latter. Deployment to Sub-Saharan Africa was associated with a higher risk of exposure to schistosomiasis and sexually transmitted infections. Deployment to a rural setting was associated with a higher risk of exposure to schistosomiasis. Aid workers employed by a non-medical organization had a higher risk of exposure to rabies risk.

Risk factors for gastrointestinal complaints during deployment

In a multivariate analysis, deployments to North and Sub-Saharan Africa and Caribbean regions, female gender, a younger age, deployment for a non-medical organization, and deployment in a rural or mixed rural/urban setting were associated with a higher risk of gastrointestinal complaints (Table 4). The duration of deployment was not associated with an increased risk.

Risk factors for malaria and adherence to malaria chemoprophylaxis

As per French guidelines, malaria chemoprophylaxis was indicated in 1225 out of 1529 (80.1%) deployments. It was taken according to prescription in 355/1225 (29.0%) of deployments, incorrectly in 252/1225 (20.6%), and not taken at all in 618/1225 (50.4%). Among those who took chemoprophylaxis according to prescription or incorrectly, 175 (40.3%) and 90 (35.7%) took Atovaquone/Proguanil, 124 (34.9%) and 108 (42.9%) took Doxycyline, and 29 (8.2%) and 9 (3.6%) took Mefloquine, respectively.

In a multivariate analysis, the following factors were associated with a higher risk of malaria during deployment: deployment to Sub-Saharan Africa; a duration longer than 1 month; deployment to a rural setting; deployment for a non-medical organization; and not taking antimalarial chemoprophylaxis or taking it incorrectly (Table 5). In the sensibility analysis considering only RDT confirmed malaria ($n = 192$), multivariate analysis showed similar results.

Discussion

This study represents one of the largest cohorts reported to date on risk-behaviour, exposure to infectious risks and medical problems encountered during deployment of humanitarian aid workers.

Despite pre-deployment consultation, self-reported health problems and exposure to infectious risks remain high in this study: out of 1529 medical visits, risk behaviour was identified in 35.3% of cases, and over 60% of aid workers encountered a health problem during deployment. Previous studies have reported higher rates of health problems among aid workers—up to 80% observed in International Red Cross volunteers[10]—and our results are more in line with rates found among other types of travellers (64% of American travellers in one study,[1] 76% of Finnish travellers in another[3]). However, 1% of our aid workers

Table 2 Self-reported exposure to risk and health problems among aid-workers during deployment, $n = 1529$

Categories		*n* (%)
Self-reported exposure to risk*	Contact with freshwater in schistosomiasis endemic areas	187 (12.2%)§
	Unprotected sexual contact	138 (9.0%)
	Bite, scratch or licking on wound by potential rabies-carrying animals	56 (3.7%)
	Accidental exposure to blood	44 (2.9%)
Health problems encountered during deployment**	Gastrointestinal disorders	487 (31.9%)
	Malaria#	237 (15.5%)¶
	Respiratory tract infections	94 (6.2%)
	Musculoskeletal conditions	58 (3.8%)
	• *Trauma/injury*	23
	• *Back pain*	23
	– *With radicular pain*	8
	• *Neck pain*	7
	– *With radicular pain*	3
	• *Knee pain*	1
	• *Others*	4
	Dermatological conditions	52 (3.4%)
	• *Skin and soft tissue infections*†	27
	• *Shingles*	3
	• *Genital wart*	1
	• *Scabies*	1
	• *Myiasis*	2
	• *Tungiasis*	2
	• *Paederus dermatitis*	1
	• *Urticaria/allergic reactions*‡	9
	• *Others*	8
	Evacuation for health reasons	19 (1.2%)
	Hospitalization during deployment	15 (1.0%)
	None	606 (39.6%)

*Multiple exposures per person are possible. **Multiple health problems per person are possible. §Exposure in 14,3% (187/1308) if limited to aid workers to schistosomiasis endemic areas. #192 confirmed by rapid diagnostic test, and 45 empirically treated ¶16.3% (237/1457) had malaria if limited to aid workers to malaria endemic areas
†Panaritium ($n = 4$); skin abscess ($n = 6$); secondary bacterial infection of existing lesions ($n = 3$); folliculitis/furunculosis ($n = 4$); cellulitis ($n = 1$); fungal skin infections ($n = 9$) ‡Food reaction ($n = 4$); drug reaction ($n = 2$); arthropod bite reaction ($n = 1$); unknown origin ($n = 2$)

were hospitalized, which is far more common than the travellers in the above-mentioned studies (0.2 and 0.4%, respectively[1,3]) and suggests that health problems in this specific population tend to be, if not more frequent, more severe. While the length of stay abroad (median of 6 months in this cohort) could be one explanation to the higher percentage of hospitalizations, the poor sanitary and living conditions probably contribute to more severe diseases.

Malaria was contracted in about one out of six deployments to malaria-endemic areas (16.3%), which is considerable, and in line with the study among International Red Cross volunteers where 11% had confirmed malaria.[10] Most malaria cases were contracted in Sub-Saharan Africa (99.2%), where *Plasmodium falciparum*, the deadliest of all malaria species, is the most common species.[13] An important contributor to this high incidence is likely the poor adherence to the antimalarial chemoprophylaxis. Only 29.0% of aid workers took antimalarial chemoprophylaxis according to prescription during their deployment, which is lower than the adherence rates found among volunteers of the Peace Corps as reported in 2013 (73.0%)[14] and 2017 (57.0%),[15] or those from the International Red Cross in 2003 (35%)[9] and in 2022 (43%).[10] It must be noted that aid-workers living in malaria-endemic countries were excluded from the analysis in this last study, as chemoprophylaxis is not recommended for this population in Swiss guidelines.[10] One possible explanation of this poor adherence in our study could be that many volunteers were of foreign origin, from malaria-endemic countries and were thus more likely to choose standby treatment rather than chemoprophylaxis, but due to missing data, it was impossible to check this hypothesis. Previous studies have analysed reasons of non-compliance, the main one being mere oversight (up to 90% volunteers of the Peace Corps).[14] Other reasons included fear of adverse effects—including among those who had not experienced any—conflicting advice, or believing an area is not endemic for malaria, all for which a pre-deployment consultation could be helpful and should emphasize on the severity of the illness, especially in a non-immune population. Moreover, a longer duration of deployment was associated with a higher chance of contracting malaria—a result linked to the long duration of stay, but possibly also to decreased adherence to malaria chemoprophylaxis over time, as shown in other studies where compliance significantly decreased as missions lengthened.[9,10,16] For this reason, pre-deployment consultations should emphasize the necessity for antimalarial chemoprophylaxis throughout the whole deployment, especially for deployments in high-risk areas like West Africa. A cost-benefit analysis carried out in the United Kingdom was in favour of chemoprophylaxis in such travellers, even for a long duration of stay.[17] However; the most

Table 3 Population description of aid-workers attending post-deployment medical consultations, by self-reported exposure to risk

Categories	Number of patients by category	Schistosomiasis exposure[#] (*n*, %)[†] (*n* = 187)	Unprotected sexual contact (*n*, %)[†] (*n* = 138)	Rabies exposure[#] (*n*, %)[†] (*n* = 56)
Age (years)				
18–30 years	260	**70 (26.9%)***	**32 (12.3%)***	**23 (8.9%)***
31–40 years	696	75 (10.8%)	70 (10.1%)	21 (3.0%)
41–50 years	371	30 (8.1%)	26 (7.0%)	8 (2.2%)
51–60 years	174	11 (6.3%)	10 (5.8%)	4 (2.3%)
≥ 61 years	28	1 (3.6%)	0 (0.0%)	0 (0.0%)
Sex				
Male	811	87 (10.7%)	66 (9.2%)	21 (2.6%)
Female	718	100 (13.9%)	72 (8.9%)	**35 (4.9%)***
Duration of travel				
≤ 1 month	154	6 (3.9%)	3 (2.0%)	1 (0.7%)
>1–6 months	664	**75 (11.3%)***	**49 (7.4%)***	**24 (3.6%)**
>6–12 months	448	**64 (14.3%)***	**59 (13.2%)***	**19 (4.2%)**
>12 months	263	**42 (16.0%)***	**27 (10.3%)***	**12 (4.6%)**
Region of deployment				
Africa	1119	**169 (15.1%)***	**113 (10.1%)***	41 (3.7%)
Outside of Africa	410	18 (4.4%)	25 (6.1%)	15 (3.7%)
Setting of deployment				
Predominantly urban	463	42 (9.1%)	54 (11.7%)	23 (5.0%)
Predominantly rural	214	**35 (16.4%)***	22 (10.3%)	11 (5.1%)
Mix rural and urban	413	57 (13.8%)*	33 (8.0%)	15 (3.6%)
Type of organization				
Medical organization	1321	149 (11.3%)	116 (8.8%)	32 (2.4%)
Non-medical organization	204	38 (18.6%)*	22 (10.8%)	**24 (11.8%)***

[#]Schistosomiasis exposure: freshwater contact in schistosomiasis endemic regions; rabies exposure: bite, scratch or licking on wound by a potential rabies-carrying animal. *$P < 0.05$ in univariate analysis, **Bold print**: $p < 0.05$ in multivariate analysis [†]Percentage exposed by line/category

important measures for long duration travels remains awareness of malaria risk, bed net and rapid diagnostic test availability. Finally, deployment in a rural area also seems to be associated with a higher risk of malaria but cannot be asserted due to the large number of missing data. Identifying these at-risk subgroups could help to implement targeted proactive prevention strategies, such as monoclonal antibodies against malaria, which might increase adherence to malaria chemoprophylaxis.[18] In a recent phase-2 trial, a single intravenous infusion of monoclonal antibodies (CIS43LS) was found to be protective against *P. falciparum* infections in healthy adults in Mali over a 6-month malaria season, with an efficacy of 88.2% compared with placebo ([79.3–93.3], $P < 0.001$).[18] These results are encouraging, and antibodies could be of interest for long-term travellers, such as expatriates or humanitarian aid workers.

In about one-third of deployments volunteers encountered gastrointestinal disorders, with similar findings reported in health care volunteers among which 21% reported diarrhoea.[19] Higher rates would be expected considering the prevalence among other types of travellers (up to 69% in some studies[1,3]) and the substandard sanitary and living conditions to which aid workers are often exposed. Our relatively low rate may be the result of the advice given during pre-deployment consultations, or simply due to memory bias, as aid workers are often exposed to more serious health issues and gastrointestinal problems are often regarded as minor. Deployment to the African continent, a younger age and deployment to a rural setting were associated with gastrointestinal problems. In our study, females also seem to present a higher risk of gastrointestinal disorders. Although it is unlikely to avoid all gastrointestinal infections, advice on hand washing and food and drink hygiene during pre-deployment consultation is of importance.

Other health issues included dermatological and musculoskeletal problems. Dermatological problems were reported in 3.4% of deployments, which is less frequent compared with results found among other travellers (8–17%)[1,3,4] or aid workers (16–19%).[9,10] Our result is probably underestimated because of recall bias, most dermatological problems reported were those found upon examination during the post-deployment medical visit. Skin and soft tissue infections were more frequent compared with other travellers (51.9% vs 28,1%) as was shingles (5.8% vs 1.5%), a possible consequence of the poor living conditions and stressful work environment during deployments.[20] As in other travellers, tropical diseases remained uncommon. Musculoskeletal problems were reported in 3.8% of deployments, a lot less than the 16% previously reported in aid workers.[9,10] Although accidents and injuries were the main cause of the disorders, they remained less common than among other travellers (1.5% vs 4% reported in a large cohort of American travellers).[1]

Among risk behaviours, 14.3% reported an exposure to freshwater in a schistosomiasis endemic region, with a higher risk in volunteers aged 18–30, and for long duration deployments in Africa, particularly in rural settings. A similar risk was observed in UK short-term volunteers from the same age range, travelling to developing countries, with 12.8% of 413 volunteers reporting exposure to freshwater, mostly in East Africa.[21] It is known that schistosomiasis is more frequent in missionaries, volunteers and

Table 4 Risk factors for gastrointestinal disorders among aid-workers during deployment*

Categories	Number of patients by category	Cases ($n = 487$)	OR (unadjusted) [95% CI]	OR (adjusted) [95% CI]	*P* value
Region of deployment					
Sub-Saharan Africa	1119	372 (33.2%)	**2.0 [1.4–3.0]**	**1.8 [1.2–2.7]**	**0.008**
Middle East	171	34 (19.9%)	ref	ref	-
Central and Southeast-Asia	113	41 (36.3%)	**2.3 [1.3–3.9]**	1.7 [1.0–3.0]	0.071
Caribbean	60	22 (36.7%)	**2.3 [1.2–4.5]**	**2.0 [1.0–3.9]**	**0.045**
Oceania	23	4 (17.4%)	0.8 [0.3–2.7]	0.8 [0.2–2.6]	
North Africa	13	6 (46.2%)	**3.5 [1.1–10.9]**	**4.1 [1.2–14.2]**	**0.024**
South America	10	2 (20.0%)	1.0 [0.2–5.0]	0.7 [0.1–3.7]	
Others and Multiple regions	20	6 (30.0%)	1.7 [0.6–4.8]	1.3 [0.5–3.8]	
Age (categories)					
18–30 years	260	124 (47.7%)	**2.3 [1.6–3.4]**	**1.8 [1.2–2.7]**	**0.009**
31–40 years	696	220 (31.6%)	1.2 ([0.8–1.7]	1.0 [0.8–1.6]	
41–50 years	371	86 (23.2%)	0.8 [0.5–1.1]	0.7 [0.5–1.1]	
≥ 51 years	202	57 (28.2%)	ref	ref	
Sex					
Female	718	286 (39.8%)	**2.0 [1.6–2.5]**	**2.0 [1.6–2.5]**	**<0.001**
Male	811	201 (24.8%)	ref	ref	
Duration of deployment					
≤ 1 month	154	59 (38.3%)	ref	ref	
>1–6 months	664	223 (33.6%)	0.8 [0.6–1.2]		
>6–12 months	448	134 (29.9%)	0.7 [0.5–1.0]		
>12 months	263	71 (27.0%)	**0.6 [0.4–0.9]**		
Type of organization					
Medical organization	1321	387 (29.3%)	ref	ref	
Non-medical organization	204	97 (47.6%)	**2.2 [1.6–3.0]**	**1.8 [1.3–2.5]**	**<0.001**
Setting of deployment					
Predominantly urban	463	136 (29.4%)	ref	ref	
Mix rural and urban	413	145 (35.1%)	1.3 [1.0–1.7]	**1.4 [1.1–1.9]**	**0.020**
Predominantly rural	214	101 (47.2%)	**2.1 [1.5–3.0]**	**2.2 [1.6–3.2]**	**<0.001**

*Proportions are specified by table's rows and results with *P* value < 0.05 are indicated in **bold**.

expatriates,[22] especially in African countries, which accounts for 95% of cases in European travellers and migrants.[23] Our findings emphasize the need for adequate pre-deployment consultation on the risk of exposure to schistosomiasis. Routine screening for schistosomiasis post-deployment in endemic zones should also be encouraged.

Regarding exposure to other infectious risks, 9% of humanitarian aid workers reported unprotected sex with someone other than a regular partner, which is similar to results found in a study among UK Voluntary Service Overseas volunteers where it was reported in 11.1%, with a higher risk in volunteers aged 26–45.[24] In our study, risk factors for unprotected sex were younger age (18–30 years), long duration of deployment and deployment in the African region. Forty-four (2.9%) aid workers experienced an accidental exposure to blood. These findings are similar to those found in high risk health care workers travelling abroad for work.[25] The risk for accidental blood-exposure could be higher in resource-poor settings.[26] In our study, no information was available on the behaviour adopted in the event of a blood exposure accident, and whether a post-exposure prophylaxis was taken to avoid HIV transmission.

We found a high rate (3.7%) of exposure to a rabies risk compared with other travellers, among which the risk is usually estimated < 1%.[27] Stray animals are more likely to be encountered in areas affected by conflict or natural disaster, which could partly explain our result. Exposure rates were highest in the subgroup of 18–30 years old (8.9%), which is in line with results found among German non-governmental organizations volunteers from the same age range (10%).[28] Beside young age, other risk factors include a longer duration of deployment (more than 1 month) and the female gender. Similarly, a study in volunteers in Nepal found higher risk exposure to rabies in women.[29] This underscores the importance of pre-exposure vaccination against rabies in this subset, especially for long duration deployments, all the more so that aid workers are often deployed in areas with limited access to healthcare, lacking vaccines or rabies immunoglobulins.

Interestingly, we found a higher risk for volunteers employed by a non-medical organization compared with a medical organization regarding gastrointestinal disorders, malaria or rabies risk exposure. This finding could be related to a better awareness of risks and prevention means within an organization that provides a global medical environment compared with an organization in which health issues during travel are only approached on an individual basis during the pre-travel consultation. Another explanation could be related to better knowledge on infectious risks and on their prevention during deployment in health care workers according to non-medical aid workers.[30] A younger age

Table 5 Predictors of malaria (confirmed or empirically treated, $n = 237$) among aid-workers during deployment*

Categories	Number of patients by category	Cases	OR (unadjusted) (95% CI)	OR (adjusted) (95% CI)	*P* value
Region of deployment					
Sub-Saharan Africa	1119	235 (21%)	**35.9 [11.4–112.7]**	**25.2 [4.7–135.7]**	**<0.001**
Other than Sub-Saharan Africa	410	2 (0.5%)#	ref	ref	
Age (categories)					
18–30 years	260	40 (15.4%)	1.1 [0.6–1.8]		
31–40 years	696	109 (15.7%)	1.1 [0.7–1.7]		
41–50 years	371	59 (15.9%)	1.1 [0.7–1.8]		
≥ 51 years	202	29 (14.4%)	ref		
Sex					
Female	718	86 (12.0%)	-		
Male	811	151 (18.6%)	**1.7 [1.3–2.2]**	-	
Duration of deployment					
≤ 1 month	154	5 (3.3%)	ref	ref	
>1–6 months	664	89 (13.4%)	**4.6 [1.8–11.6]**	**5.1 [2.0–12.9]**	**0.001**
>6–12 months	448	85 (19.0%)	**7.0 [2.8–17.5]**	**6.7 [2.6–17.2]**	**<0.001**
>12 months	263	58 (22.1%)	**8.4 [3.3–21.5]**	**8.6 [3.3–22.5]**	**<0.001**
Antimalarial chemoprophylaxis					
Not indicated	304	2 (0.7%)	0.07 [0.02–0.3]	1.3 [0.2–10.8]	0.795
Indicated, not taken	618	144 (23.3%)	**3.2 [2.1–4.8]**	**2.9 [1.9–4.6]**	**<0.001**
Taken, but inadequately	252	60 (23.8%)	**3.3 [2.0–5.2]**	**3.1 [1.9–5.1]**	**<0.001**
Compliance with prescription	355	31 (8.7%)	ref	ref	-
Type of organization					
Medical organization	1321	188 (14.2%)	ref	-	
Non-medical organization	204	49 (24.0%)	**1.9 [1.3–2.7]**	**1.6 [1.1–2.4]**	**0.017**
Setting of deployment					
Predominantly urban	463	55 (11.9%)	ref	ref	
Mix rural and urban	413	68 (16.5%)	1.5 [1.0–2.1]	1.3 [0.8–1.9]	0.264
Predominantly rural	214	50 (23.4%)	**2.3 [1.5–3.5]**	**2.2 [1.4–3.5]**	**0.001**

*Proportions are specified by table's rows and results with P value < 0.05 are indicated in **bold**. #1 case in Bangladesh, 1 in Iraq.

was also associated with more risk behaviours, particularly for bathing in freshwater in regions endemic for schistosomiasis or having unprotected sexual contacts. As discussed above, these findings must guide pre- and post-deployment consultations with an emphasis on raising awareness before deployment and routine screening for schistosomiasis but also for sexually transmitted diseases after deployment, especially in younger adults.

Identifying risks can help in the development of mission-specific recommendations for risk mitigation and, for instance, guide the advice on mission specific first-aid kits.[31,32]

Our study has several limitations: the retrospective character and the reliance on self-reporting make this report at risk of selection- and recall-bias. In addition, not all aid workers that visited our pre-deployment consultation had a post-deployment one, leading to a possible overestimated rate of health problems encountered during travel, in which case volunteers are more likely to ask for a post-deployment consultation. Part of our pre-deployment consultation focuses on preventive measures aimed at preventing gastrointestinal infections but also vector-borne diseases, such as bed net use or insect repellent for the skin. Unfortunately, our standard questionnaire does not record adherence to recommendations regarding these preventive measures. In addition, our data do not quantify the number of exposures to a certain risk. Regarding sexual contact for instance, we do not record the nature and frequency nor the partner that was involved. Moreover, the number of episodes for a health problem is often unknown.

To limit these biases, we are currently developing a prospective observational study in travellers—including for humanitarian purposes and regardless the duration of travel—who will be asked weekly questions about exposure, preventive measures, health problems and threats to safety encountered during travel or deployment. This will reduce selection- and recall- bias and selection bias associated with a retrospective study. In addition, it will provide insights in the incidence and duration of health-care problems during travel or deployment and will allow us to identify risk factors for exposure and health-care problems with greater precision.

Conclusion

Humanitarian aid workers deployed abroad encounter significant rates of health problems—especially malaria—and risk exposure to infectious diseases during their deployment. In this large cohort, we highlight the greatest risk among young people, in rural areas, and among those working for non-medical organizations. These findings should guide future pre-deployment consultations, as discussing risks could increase risk awareness and potentially reduce risk behaviour during deployment, as well as adherence to medical advice such as malaria chemoprophylaxis.

Our findings also suggest the need for screening, upon return, for specific infectious diseases in case of exposure.

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Ghania Benabdelmoumen (Conceptualization-Supporting, Investigation-Equal, Writing—review & editing-Equal), Rob Van der Pluijm (Methodology-Equal, Writing—original draft-Lead, Writing—review & editing-Equal), Fabien Taieb (Data curation-Lead, Formal analysis-Lead, Methodology-Equal, Writing—original draft-Supporting, Writing—review & editing-Equal), Kaoutar Jidar (Formal analysis-Supporting, Writing—review & editing-Equal), Lucie Kuhmel (Investigation-Equal, Writing—review & editing-Equal), Cora Lucet Investigation-Equal, Writing—review & editing-Equal), Pierre Buffet (Writing—review & editing-Equal), Patrick Hochedez (Writing—review & editing-Equal), Oula Itani (Writing—review & editing-Equal), Paul-Henri Consigny (Conceptualization-Lead, Methodology-Equal, Writing—original draft-Supporting, Writing—review & editing-Lead).

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Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. Hill DR. Health problems in a large cohort of Americans traveling to developing countries. *J Travel Med* 2000; **7**:259–66.
2. Visser JT, Edwards CA. Dengue fever, tuberculosis, human immunodeficiency virus, and hepatitis C virus conversion in a group of long-term development aid workers. *J Travel Med* 2013; **20**:361–7.
3. Vilkman K, Pakkanen SH, Lääveri T, Siikamäki H, Kantele A. Travelers' health problems and behavior: prospective study with post-travel follow-up. *BMC Infect Dis* 2016; **16**:328.
4. Stefanati A, Pierobon A, Baccello V *et al.* Travellers' risk behaviors and health problems: post-travel follow up in two travel medicine centers in Italy. *Infect Dis Now* 2021; **51**:279–84.
5. Bhandari D, Pandey P. Health problems while working as a volunteer or humanitarian aid worker in post-earthquake Nepal. *JNMA J Nepal Med Assoc* 2018; **56**:691–5.
6. Wolf T, Ellwanger R, Goetsch U, Wetzstein N, Gottschalk R. Fifty years of imported Lassa fever: a systematic review of primary and secondary cases. *J Travel Med* 2020; **27**.
7. Wolf T, Kann G, Becker S *et al.* Severe Ebola virus disease with vascular leakage and multiorgan failure: treatment of a patient in intensive care. *Lancet* 2015; **385**:1428–35.
8. Morokuma N, Chiu CH. Trends and characteristics of security incidents involving aid workers in health care settings: a 20-year review. *Prehosp Disaster Med* 2019; **34**:265–73.
9. Dahlgren AL, Deroo L, Avril J *et al.* Health risks and risk-taking behaviors among International Committee of the red Cross (ICRC) expatriates returning from humanitarian missions. *J Travel Med* 2009; **16**:382–90.
10. Guisolan SC, Ambrogi M, Meeussen A, Althaus F, Eperon G. Health and security risks of humanitarian aid workers during field missions: experience of the International Red Cross. *Travel Med Infect Dis* 2022; **46**:102275.
11. WHO. *Schistosomiasis [Internet]*. [updated 2023 Feb 1; cited 2023 Dec 17]. Available from: https://www.who.int/news-room/fact-sheets/detail/schistosomiasis
12. Delaigue S, Signolet I, Consigny PH *et al.* New guidelines for the prevention of imported malaria in France. *Med Mal Infect* 2020; **50**:113–26.
13. WHO. *World Malaria Report 2022* [Internet]. [cited 2023 Dec 16]. Available from: https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2022
14. Landman KZ, Tan KR, Arguin PM. Adherence to malaria prophylaxis among Peace Corps Volunteers in the Africa region, 2013. *Travel Med Infect Dis* 2015; **13**:61–8.
15. Tan KR, Henderson SJ, Williamson J *et al.* Long term health outcomes among returned peace corps volunteers after malaria prophylaxis, 1995-2014. *Travel Med Infect Dis* 2017; **17**:50–5.
16. Hamer DH, Ruffing R, Callahan MV, Lyons SH, Abdullah ASM. Knowledge and use of measures to reduce health risks by corporate expatriate employees in western Ghana. *J Travel Med* 2008; **15**:237–42.
17. Massad E, Behrens BC, Coutinho FAB, Behrens RH. Cost risk benefit analysis to support chemoprophylaxis policy for travellers to malaria endemic countries. *Malar J* 2011; **10**:130.
18. Kayentao K, Ongoiba A, Preston AC *et al.* Safety and efficacy of a monoclonal antibody against malaria in Mali. *N Engl J Med* 2022; **387**:1833–42.
19. Balaban V, Warnock E, Ramana Dhara V, Jean-Louis LA, Sotir MJ, Kozarsky P. Health risks, travel preparation, and illness among public health professionals during international travel. *Travel Med Infect Dis* 2014; **12**:349–54.
20. Faucon C, Godefroy N, Itani O *et al.* Arthropod exposure accounts for about half of skin disorders in returning travellers. *J Travel Med* 2022; **29**.
21. Wyler N, Green S, Boddington N, Davies C, Friedli K, Lankester T. Travel related illness in short-term volunteers from the UK to developing countries. *Travel Med Infect Dis* 2012; **10**:172–8.
22. Nicolls DJ, Weld LH, Schwartz E *et al.* Characteristics of schistosomiasis in travelers reported to the GeoSentinel surveillance network 1997-2008. *Am J Trop Med Hyg* 2008; **79**:729–34.
23. Lingscheid T, Kurth F, Clerinx J *et al.* Schistosomiasis in European Travelers and migrants: analysis of 14 years TropNet surveillance data. *Am J Trop Med Hyg* 2017; **97**:567–74.
24. Bhatta P, Simkhada P, Teijlingen E, Maybin S. A questionnaire study of Voluntary Service Overseas (VSO) volunteers: health risk and problems encountered. *J Travel Med* 2009; **16**:332–7.
25. Uslan DZ, Virk A. Postexposure chemoprophylaxis for occupational exposure to human immunodeficiency virus in traveling health care workers. *J Travel Med* 2005; **12**:14–8.
26. Vaid N, Langan KM, Maude RJ. Post-exposure prophylaxis in resource-poor settings: review and recommendations for pre-departure risk assessment and planning for expatriate healthcare workers. *Trop Med Int Health* 2013; **18**:588–95.
27. Steffen R, Chen LH, Leggat PA. Travel vaccines-priorities determined by incidence and impact. *J Travel Med* 2023; **30**:taad085.
28. Küpper T, Rieke B, Neppach K, Morrison A, Martin J. Health hazards and medical treatment of volunteers aged 18-30 years

working in international social projects of non-governmental organizations (NGO). *Travel Med Infect Dis* 2014; **12**: 385–95.
29. Pandey P, Shlim DR, Cave W, Springer MFB. Risk of possible exposure to rabies among tourists and foreign residents in Nepal. *J Travel Med* 2002; **9**:127–31.
30. Goesch JN, Simons de Fanti A, Béchet S, Consigny PH. Comparison of knowledge on travel related health risks and their prevention among humanitarian aid workers and other travellers consulting at the Institut Pasteur travel clinic in Paris, France. *Travel Med Infect Dis* 2010; **8**:364–72.
31. Kortepeter MG, Seaworth BJ, Tasker SA, Burgess TH, Coldren RL, Aronson NE. Health care workers and researchers traveling to developing-world clinical settings: disease transmission risk and mitigation. *Clin Infect Dis* 2010; **51**:1298–305.
32. Costa M, Oberholzer-Riss M, Hatz C, Steffen R, Puhan M, Schlagenhauf P. Pre-travel health advice guidelines for humanitarian workers: a systematic review. *Travel Med Infect Dis* 2015; **13**:449–65.