Tropical infections as occupational diseases among young volunteers in social projects

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Abstract

Purpose: The trend of volunteering overseas has increased tremendously over the last decade. Volunteers often go to regions where they are exposed to tropical infections like malaria, dengue, typhoid fever and schistosomiasis. Health assessments have shown a high occurrence of tropical infections among young volunteers. Such tropical infections are notifiable in Germany, as they are covered by a separate branch of the social insurance system. However, there is still limited data on systematical improvement of medical prevention and health care for volunteers.

Methods: This retrospective study included 457 cases with a diagnosis for a tropical infection or typhoid fever from January 2016 to December 2019. Data sets were anonymised and then analysed with descriptive statistics first. Cases of volunteers send abroad by “Weltwärts” were compared to cases of aid workers send to non-industrial countries.

Results: A high occurrence of tropical infections as occupational diseases has been shown for volunteers compared to other (mostly older) aid workers being sent to tropical regions. The risk of acquiring a tropical infection was significantly higher in Africa compared to other tropical regions. Significantly, more volunteers were diagnosed with malaria during the period under review. Medical check-ups after travel were rare among volunteers.

Conclusions: Data imply a disproportionate risk for malaria in Africa with a higher risk of acquiring falciparum malaria in Sub-Saharan regions. Region-specific risks need to be addressed in training seminars in order to raise awareness among young volunteers before travel. Medical examinations after travel should be mandatory and specific to a particular region.

Introduction

In the last sixty years, the number of aid organizations sending aid workers abroad has multiplied. Aid workers were mostly experienced people with some kind of special training in their field of work. In the past two decades a new form of humanitarian work, called volunteering, was established and has since then increased tremendously. In 2008, the so called “Weltwärts” program was founded in Germany, sending young volunteers at the age of 18 to 28 to social projects worldwide for one year Anonymous (2021b). This type of intercultural exchange which the young volunteers experience, promote their personal development but also exposes them to new health risks they are not always aware of. As stated in other studies, “their idealism is often bigger than their risk perception” (Martin et al. 2012) and so they engage in risky behavior promoting the occurrence of frequent tropical infections like malaria (Anonymous 2020b), dengue, typhoid fever or schistosomiasis (Kiehl 2011). In order to prevent such diseases, volunteers being send to the tropical regions (tropics) must undergo a mandatory pre-travel medical examination and receive pre-travel health advice (Prüfer-Krämer et al. 2020). This preventive measure has been in effect since 2019.

By law, Weltwärts-volunteers with a German work contract being send abroad are covered under the labour protection act just like any other working people in German (Anonymous 2008). A suspected diagnosis for a tropical illness during the period of the voluntary work in the tropics must therefore be reported as occupational disease by the doctor and the employer if the procedural requirements to get such a disease at work are fulfilled. If professional work in the tropics has exposed an employee to diseases that do not exist in Germany and it is likely that the disease was acquired at work and not otherwise, then contracting such a disease is considered a consequence of the work contract and fulfills therefore the procedural requirements. This so-called “double causality” (diagnosis and exposure at work) may be required e.g. for Hepatitis B when a medical person is working with patients but it would be hard to connect the diagnosis with occupational exposure in the case of a bureau job. The first case would fulfill the requirement of double causality, the latter normally not. In most countries occupational diseases are listed. In Germany, the diagnoses of tropical occupational diseases investigated in this study are coded as BK-3104.

It has been suspected that occupational diseases by infections occur more frequently among young volunteers than among the comparative group of mostly older aid worker (Martin et al. 2012). However, there is limited data and therefore any strategy to improve medical prevention and health care among young volunteers in the tropics is so far limited.

Material And Methods

A total of 457 anonymised data sets with cases recommended for recognition as occupational disease which are classified as BK-3104 (occupational tropical disease) have been analysed retrospectively. Reports from January 2016 to December 2019 were included in the analysis. More recent cases were excluded because most volunteers returned ahead of time because of the Covid-19 pandemic and their short stay abroad would have caused a significant bias. The cases consisted of notifications about young volunteers deployed by the German “Weltwärts” program as well as cases from mostly aid workers all addressed to the “Unfallversicherung für Bund und Bahn” (UVB; “accident insurance for government and railway”) as statutory insurance agency. Disease frequencies were then analysed in geographic subgroups. Weltwärts”-volunteers will be named “volunteers” in this paper. Recommendation for recognition depended on diagnostic reliability and suitable clinic. Diagnostic methods abroad were often limited and the quality of case reports differed significantly from extensive documentation to screenshots of handwritten laboratory results. Special attention was paid to the most occurring tropical diseases such as malaria, dengue, typhoid fever and schistosomiasis.

All data were compiled in an excel sheet and evaluated with SPSS (version 27). For the evaluation of differences between groups, data was checked for normal distribution. Such data was tested with Student t-test, others with non-parametric tests (Chi square test, Mann Withney U-Test). $P<0.05$ was defined as significant. The project obtained approval from the ethics committee of RWTH Aachen University, Aachen / Germany (EK 078-21).

Results

This study included a total of 457 files of patients where an occupational disease was suspected. 290 (63.5%) of them were volunteers and 167 (36.5%) aid workers. 76% of the volunteers were females in contrast to 53% in the group of aid workers (P<0.001). Mean age of the volunteers was 19 years and they stayed abroad for an average time of 11 months or 343 days (range 62 to 1198). The aid workers were significantly older (20 to 65 years, P<0.001), with one third of all aid workers being between 28 and 34 years old at the time of departure from their working regions. They stayed significantly longer abroad (p<0.01) for a mean of 2.5 years or 925 days (range 5 to 3756). The diseases leading to a notification followed the departure with a mean delay of 182 days (range 4 to 667) for volunteers and 710 days (range 5 to 3938) for aid workers (p<0.01).

4.1 Travel destinations

A total of 14.052 volunteers were sent overseas to 65 different countries (Figure 1) in the period under review (David Hingley, Engagement Global, personal communication, 16.03.2021). 45% were sent to Latin America, 36% to Africa, and 19% to Asia or Oceania (Table 1). Significant regional differences were found for diagnoses for tropical diseases classified as BK-3104 between volunteer cases from Africa and those from other parts worldwide (p<0.01). 3.6% (185/5103) of all volunteer cases sent to Africa had a diagnosis of a tropical infection, in contrast to 1.7% (43/2641) sent to Asia and only 0.5% (32/6308) sent to Latin America for the period from 2015 to 2018 (Figure 2).

All data for the comparison of the occurrence of tropical infections among aid worker came exclusively from the cases reported to the assurance company UVB. Even though the cases of aid workers came mainly from sending institutions like “Gesellschaft für internationale Zusammenarbeit” (GIZ) and “Arbeitsgemeinschaft für Entwicklungshilfe (AGEH) / Agiamondo”, exact numbers of aid workers sent abroad for the period under review could not be provided. Therefore, only files of aid workers with a diagnosed tropical occupational disease were analysed in this study. Further, percentage rates of diagnoses conducted for the total number of aid workers could not be calculated. Out of all the analysed aid worker cases (n=167), 67% of the cases were diagnosed with an occupational disease according to BK-3104 for aid workers who had been working or were at that time still working in Africa (112/167). In addition, 24% (41/167) had been to Asia and only 8% to Latin America. However, only in one case the aid worker had traveled within Europe.

4.2 Tropical illnesses

Among all reported diagnoses of occupational illnesses among volunteers (N=290), the most common diagnosis was malaria with 54.5% (158/290, Table 2). Further, 19.7% (57/290) of volunteers got a diagnosis for dengue fever. In addition, typhoid fever was reported in 14.1% (41/290) and schistosomiasis in 5.9% (17/290). Besides, 8.6% of all reported diagnoses among volunteers were

summarized as “other diseases” from which 10 out of the 25 were for amoebiasis and a few for giardiasis, chikungunya, or cholera.

For aid workers, only 37.1% (62/167) of the cases were reported with a malaria diagnosis and 19.8% had an infection with dengue (33/167, Table 2). Moreover, 23.4% (39/167) were diagnosed with schistosomiasis and only 4/167 had typhoid fever. The diagnosis rate for “other diagnoses” was 18.6% (31/167). Among these, 7 were for giardiasis, 6 for amoebiasis and 4 cases of chikungunya. For malaria, there was a significant difference between case numbers of volunteers and aid workers, with volunteers getting significantly more diagnoses ($p<0.01$). Schistosomiasis on the other hand was diagnosed significantly more often among aid workers ($p<0.01$) (Table 2).

4.2.1 Malaria in Africa

In this study, malaria was accepted as proven when a microscopy result or a rapid dipstick test was documented to be positive. In other cases, malaria was just clinically suspected and treated as such, leaving the question whether the diagnosis was correct or not. For all malaria cases among volunteers and aid workers (n=219), all except one case were reported to have taken place in Africa and more than half of those in West Africa (127/219). Half of all malaria diagnoses in Africa were based on an infection with plasmodium falciparum (114/219). In West Africa even 57% of the malaria cases were confirmed infections with plasmodium falciparum (72/127; Figure 4). Further, only three malaria cases were caused by plasmodium vivax.

Volunteers, who lived and worked in Africa were significantly more at risk ($p<0.01$) to get a diagnosis for one or even several tropical diseases. The risk of illness differed considerably from country to country. Out of 205 cases from volunteers who traveled to Togo between 2015 and 2018, only in 18% (37) of cases were diagnosed as tropical diseases. For cases from volunteers in Benin, diagnosis rate was 14% (11/78) and 7% (52/776) for Ghana. For South Africa, the diagnosis rate for an occupational disease was made only in 2 cases out of 1,352 volunteers who traveled there.

4.2.2 Dengue cases in India

Regarding the occurrence of dengue among volunteers and aid workers, data suggest that the incidence for dengue was significantly higher in India ($p<0.01$) compared to the number of dengue cases among those who had traveled worldwide to other countries than India (64). A total of 26/90 dengue cases were diagnosed in India during the period under review or after the service there (Figure 5) and 23 out of 26 were volunteers. There were only 6 cases from those who travelled to India with another diagnosis than dengue.

4.2.3 Schistosomiasis and typhoid fever

Diagnoses of schistosomiasis were only found among cases of volunteers and aid workers who had worked in Asia and Africa with significantly more cases in Uganda ($p<0.01$). This corresponds to 30.4% (17/56) of all reported cases for schistosomiasis.

Diagnoses for typhoid fever were mainly made in Africa and significantly more in one country in America, Peru ($p<0.01$), to which 33.3% (15/45) of the diagnoses reported can be attributed.

4.3 Mandatory pre and post travel examinations

Regarding the medical check-ups the volunteers and aid workers had received, this study has revealed that of all volunteers, only 38% (110/290) had undergone pre-travel medical checks, compared to 95% (159/167) among aid workers ($P<0.001$, Table 3). In addition, only 23% (66/290) of the volunteers had received a follow-up examination after their return to Germany, whereas 86% (143/167) of the aid workers had one ($P<0.001$). The suspected diagnosis was made in 96% (279/290) of the cases from volunteers in the host country and in 62% (104/167) of the cases from aid workers who were at that time abroad ($P<0.01$; Table 3).

4.4 Recognition as occupational disease

The total recognition rate of diagnoses as occupational disease was almost equal among both groups being investigated (65% among volunteers and 64% among aid worker, Table 4). The proportion of diagnoses recognized as occupational disease differed depending on the disease. Out of malaria notifications, 84% among volunteers and 87% among aid worker were accepted. For dengue fever, it was about 79% of the volunteer cases and 70% of the aid worker's cases. None of the suspected cases for typhoid fever were solely recognized as occupational disease. In total, only 5 cases with the co-disease typhoid fever were recognized, all of them with a concomitant malaria as reason for the recognition. Only few cases of schistosomiasis met the criteria for recognition as occupational disease, 18% (3/17) among volunteers and 44% (17/39) among aid workers. About 28% (11/39) of the diagnoses for schistosomiasis among aid workers were made during a follow-up examination after return from abroad. Most of those (26/39) were made upon positive IgG anti-bodies. Furthermore, 31/39 schistosomiasis cases among aid worker occurred in Africa. For volunteers, only 3/17 were diagnosed during a follow-up and for those diagnosed abroad, in 62% of the cases, a rapid dipstick test for schistosomiasis was used, a method only used twice among aid workers (Table 4).

Discussion

5.1 Pre-travel preparations

"Occupational travel to tropical countries among Germans has more than doubled in the past five years" (Jansing et al. 2021). The number of young volunteers going abroad has also increased tremendously in

the last decade (Anonymous 2019), including the number of international travels in general. Health related issues occur for a good number of travelers. Therefore, this needs to be addressed, particularly regarding the higher exposure to tropical infections among volunteers and aid workers often living in rural regions for longer periods (months or even years). As other studies have already shown, risk behavior and risk perception among volunteers depends strongly on the intensity of pre travel training and medical advice given (Jansing et al. 2021), (Han, Balaban, and Marano 2010). The importance of information on preventive behavior and education in self-management skills before travel was stated by a recent study (Sasayama, Gilmour, and Ota 2021). This particular study showed that even after having taken a health lecture, only 40% of people knew about the more dangerous risks like malaria and dengue. Obviously, just hearing about a health lecture is not sufficient for volunteers to understand the severity of existing health hazards they will be exposed to in the regions they visit. Specific training to develop self-management skills is therefore crucial for their better understanding of potential threats and how to react upon them. Studies have also addressed the issue of proper preparation (Sasayama, Gilmour, and Ota 2021). In another survey, only 70% of relief aid workers interviewed stated to have taken a pre-travel medical examination and only every fourth person had used a mosquito-net or repellents to protect themselves against malaria or dengue fever (Sharp et al. 2006). Regarding international travel, “malaria especially, continues to threaten international travelers due to inadequate perception of risk and sub-optimal pre-travel preparations” (Angelo et al. 2017).

These previously described risky behaviors, seem indeed to represent one of the biggest risks, causing diseases such as malaria and dengue to occur more frequently than necessary. Not only do volunteers behave risky despite pre-travel health advice (Martin et al. 2012), (Küpper et al. 2014), but studies have shown, especially regarding malaria prevention, that young people are clearly not well informed about this specific risk. Landman et al (3013) reported that adherence to malaria prophylaxis was moderate due to the fear of long-term adverse events. One out of four even reported “not worrying about malaria” although living and working in high risk regions (Landman, Tan, and Arguin 2013). This shows that there is a need of increasing information and training about prophylactic efficacy and likelihood of side effects.

Volunteers do not only have a higher risk profile than older aid workers, but they also travel to regions with underestimated health hazards resulting in possible health issues during and after their stay abroad. Therefore, not only pre-travel preparation is an ongoing issue but also the importance of medical follow ups. According to a study done in the United Kingdom in 2006 – 2007, 27% of volunteers returned from voluntary services overseas with ongoing unresolved medical problems (Bhatta et al. 2009) and more than one third of aid workers interviewed “reported worse health on return than before their mission” (Dahlgren et al. 2009). Another study found that 53% of the travelers presented themselves to hospital within one week of return and 96% within 6 months after coming back from overseas due to health problems” (O'Brien et al. 2001).

5.2 Sub-Saharan risk-regions and malaria risk

For the occurrence of occupational diseases analysed in our study, a disproportionate risk of being diagnosed with a tropical disease, above all other diseases, malaria was detected in volunteers living in Africa and especially those in Sub-Saharan / West African regions (Figure 3). Most of them were diagnosed with malaria and many of those with malaria tropica (Pl. falciparum). It is evident that the risk for malaria is higher there, as the region of West Africa, is in fact stated by the World Health Organization (WHO) as a region with an all-year high malaria risk (Anonymous 2020a). In 2020, 95% of all malaria cases were observed in Sub-Saharan-regions (Anonymus 2021). International data has already shown, that “travel to Sub-Saharan Africa and Oceania was associated with the greatest relative risk of acquiring malaria” (Angelo et al. 2017). Nonetheless results from a survey for Spanish travelers showed again the lack of potential pre-travel preventive measures as more than one third of travelers to Sub-Saharan Africa received no malaria prophylaxis (Lopez-Velez and Bayas 2007). Even more important is the preparation and importance of raising region-specific awareness for the existing health hazards for volunteers or travelers beforehand as these are the best measures to prevent an infection through a mosquito-bite.

In current study, malaria was found to be diagnosed more often among volunteers than among humanitarian aid workers and other short or long-term aid workers for the time period investigated, even though the cases of aid workers analysed in this study showed a long travel history, traveling abroad over and over to risk countries due to their work contracts. According to the volunteer cases, their stay for the voluntary service abroad was often their first travel to a tropical region involving new health hazards. The time taken from departure up to diagnosis was significantly shorter for volunteers compared to the aid workers ($p<0.01$), having most of the first diagnosis halfway through their voluntary year. Aid workers were diagnosed after a much longer stay abroad and data in this study showed that aid workers did not have more episodes of malaria whilst staying on average three times longer abroad, unlike volunteers who had up to five episodes of malaria during their shorter stay. These findings suggest continuously missing or not sufficient compliance for preventive measures, especially regarding the prevention of getting malaria through mosquito bites.

According to our findings, the risk of infection with malaria pathogen did not increase proportionally with the length of stay but there was a correlation between the stay in African regions and an infection with malaria pathogen, especially plasmodium falciparum causing malaria tropica and harboring the risk of a severe or even life-threatening case of malaria (Figure 4). A significant increased risk for the infection with plasmodium falciparum in West Africa could not be proven. There could be up to one fourth more infections with Plasmodium falciparum since 23.6% of the malaria diagnoses were made upon a positive test result of a rapid diagnostic test (RDT). Unfortunately, the types of malaria pathogen tested positive could not be detected from the data of the RDT tests.

Other studies have likewise found out, that especially travelers being exposed in Sub-Saharan regions were mostly diagnosed with malaria tropica (Angelo et al. 2017) and this supports our current hypothesis that there is a greater and often underestimated risk among young volunteers going abroad for the first time.

5.3 Suspicions for occupational diseases

More cases of suspected occupational diseases were reported among volunteers than among others, mostly aid workers, represented in this study. Malaria was shown to occur more frequently among the volunteers whereas the diagnosis for dengue fever occurred equally within both groups. The infection with dengue transmitted by a mosquito bite is only preventable with adequate use of repellents and mosquito-nets at night (Gupta and Rutledge 1994) whereas an infection with malaria pathogen can additionally be prevented through adequate chemoprophylaxis (Nauck 1956). Sadly, studies have shown how very little travelers know about the efficacy of the use of anti-malaria chemoprophylaxis or – even more effective – mosquito nets to sleep under them, and therefore the lack of taking or using them for prevention (Lopez-Velez and Bayas 2007), (Landman, Tan, and Arguin 2013). These findings suggest that volunteers do take higher risks in terms of prevention, causing more and repeated infections with malaria parasites and leading to preventable occupational diseases.

Similar behavior must be assumed regarding the lack in prevention measures taken to protect oneself against mosquito bites transferring dengue or also chikungunya. The lack of knowledge (Sasayama, Gilmour, and Ota 2021), risk perception or even willingness to protect oneself against dengue with bed nets and the daily use of repellents or chemoprophylaxis especially among young volunteers leads again to potentially preventable case numbers of tropical occupational diseases (BK-3104). Considering the geographic localization of dengue cases investigated in this study, there were significantly more dengue cases and especially among volunteers who traveled to India for their service (Figure 5). In current study, the different regions of India with dengue cases could not be differentiated as data were not detailed enough in the health reports analysed. Since India is a very popular country volunteers go to (Figure 1), it is crucial to enlighten them on potentially underestimated risk of acquiring dengue fever whilst traveling there. The WHO classified dengue risk regions in Asia as representing 70% of the global burden of the disease (Anonymous 2021c). A study analysing dengue in peace corps volunteers found the Caribbean to have highest number of dengue cases followed by East Asia and South/East Asia regions (Ferguson et al. 2016). In contrast, Latin America, where the most important number of volunteers are sent every year, did not report many cases of dengue fever. According to the WHO, a significant reduction of dengue cases was reported in the Americas in 2017 although dengue cases are increasing worldwide in the supervised risk regions with highest number of cases reported in Bangladesh, Malaysia, Philippines and Vietnam in Asia (Anonymous 2021c). Attention must therefore also be paid to increasing risk for infection with dengue worldwide especially in tropical and subtropical regions as the number of dengue cases reported to the WHO increased over 8 fold in the last two decades putting half of the world's population at risk (Anonymous 2021c).

For the occurrence of typhoid (enteric) fever, no case could be recommended for the recognition as an occupational disease as a diagnosis based on positivity of the old and unreliable Widal test alone could not be accepted, especially if clinical signs were either not reported or not compatible with a diagnosis of typhoid fever. Nonetheless attention should be paid to this infectious disease found in the tropics, highly correlating with a high fecal contamination of sanitary facilities in big cities, not only affecting locals but

also travelers and workers (Abhilasha et al. 2008). As gastrointestinal symptoms are often self-limiting and diagnostic methods are insufficient, recognition of typhoid fever is often difficult because stool tests are often negative in the first week and serological tests may be positive at a late stage of disease only or never. The traditional Widal-Test shows a low sensitivity of 65.4%, specificity of 89.8%, and accuracy of 82.1% (Maheshwari et al. 2016), (Shahapur et al. 2021). Therefore, prevention measures regarding water transmitted diseases like typhoid fever must also be addressed during training seminars as volunteers do not always have access to safe drinking water and sanitary facilities (Martin et al. 2012). It may be expected that typhoid fever is more common when more people were sent to south-east Asia, especially to Nepal and India as these countries have the highest rate of typhoid fever worldwide (Karkey et al. 2016), (Abhilasha et al. 2008).

Infestations with schistosomiasis were significantly more frequently diagnosed among aid workers, mostly based on a positive serology after their return from overseas. This may be a consequence of the longer stay of aid workers. However, there are other factors which should be taken into consideration, e.g. individual behavior: Volunteers may have had some swimming or water diving activities which often takes place far from the shore while aid workers may have walked in the water at the shore to cool down. By this, their risk would be significantly higher than those of volunteers. Housing may also be an important factor: Do people get their water as rainwater or from a pond? Unfortunately, such factors are usually not documented or reported and therefore the underlying risk factors must remain as such. Only few cases of schistosomiasis were recommended to be accepted as occupational disease, due to the fact that in most cases, single serological tests do not constitute a diagnosis in the absence of parasitological proof and that the attribution of such a positive serology to a certain exposure is often impossible (Anonymous 2017). A single serological test may be accepted as proven diagnosis, only if the person went to a risk area for the first time and the titers are high. However, an element of risk remains because in non-endemic countries some species of schistosomiasis occur, e.g. Cavu River in Corsica, and trichobilharzia occurs in Europe's swimming lakes if there are many ducks (Effelsberg 1989). These factors may cause false-positive results. Some tests may also be negatively affected antibody cross reactions (Homsana et al. 2020). With such risk elements in mind a single serological test may be acceptable in some cases but a significant shift of titers is still "Gold Standard". Diagnostic methods like the Rapid dipstick point of care test (POC) are insufficient (Ochodo et al. 2015).

Interestingly, volunteers were mostly diagnosed in their host country with the above-mentioned rapid dipstick test. Not accepting a positive POC test as valid diagnosis doesn't exclude the possibility of a schistosomiasis as the test proves the contact to the pathogen but not an active infestation (Kapaun 2004) (Casacuberta-Partal et al. 2020a). Two positive serology samples or microscopic detection of the pathogen are necessary to prove an active infection with schistosomiasis pathogen (Anonymous last updated version 10/2017)

These secure detection methods where fairly used among volunteers. A schistosomiasis screening for antibodies and preferably followed by the more sensitive up-converting phosphor lateral flow circulating anodic antigen (UPC-LF CAA) test should be encouraged after freshwater contact (Anonymous last

updated version 10/2017)

(Casacuberta-Partal et al. 2020a). In high-endemic areas serology should be analysed 12 weeks after return (Anonymous 2017), (Kapaun 2004) to detect potentially active infestations with low burden of schistosomiasis pathogen after staying abroad, as travelers may be asymptomatic on first presentation (Casacuberta-Partal et al. 2020b) and infections need to be treated early in order to prevent long-term complications in the case of chronic schistosomiasis, as liver fibrosis (Zhong et al. 2022), bladder cancer (Efared et al. 2022)and other chronic inflammations (Musaigwa et al. 2022).

5.Personal protection measures

The effectiveness of repellents and the use of insecticide impregnated bed-nets should be encouraged in order to achieve better prevention. Pre-travel checkup and mandatory follow up examinations are crucial to be able to attribute a suspected diagnosis of an illness to the past journey and to accept it as an occupational disease which occurred during the actual journey.

Unfortunately, in this study it was impossible to assess whether volunteers took recommended prevention measures like malaria chemoprophylaxis or other, non-drug-related precautions like the use of repellents or mosquito-nets according to the risk associated to particular regions they were travelling to. However, Martin et al. reported that there are deficiencies in such strategies in young people, even more pronounced than in elderly persons (Martin et al. 2012). It was impossible to track what kind of specific training and quality of medical checkups were done before the departure. Further, investigations are necessary to assess the type and adequacy in terms of preventive measures taken before, during and after travel.

Another limitation of this study is the limitation on specific pathogens considered in this study. According to the regulations, other diseases than the ones listed as occupational diseases may be accepted as occupational disease by the insurance if the occupation is at least likely the situation where the patient got the infection. The German regulations include two options here: Bk-3102 (“diseases which may be transmitted from animals to humans”) or by the so-called “extension condition”. This includes cases which are not listed as occupational disease but where the occupational exposure can be proven as the main or only risk. The former could be the case if an African tick bite fever was diagnosed. Rickettsioses were recently identified as rapidly emerging diseases and probably they are more common in returning travelers than malaria (Jensenius et al. 2003), (Jensenius et al. 2002), (Cherry et al. 2018), (Leder et al. 2013), (Bottieau et al. 2006). However, such diagnoses never occur so far in the applications for occupational disease. The latter option may be chosen when a person who is active in nature protection in national parks get anthrax. Such cases rarely occur in Namibia and Zambia, probably also in other countries, e.g. Botswana (Rob Clifford, South Luangwa Valley, personal communication 2020). Because of the total number of cases especially concerning rickettsioses more awareness of the counselling physicians is desirable.

Conclusion

This study has shown that occupational diseases categorized as tropical diseases (BK-3104) occur significantly more often among young volunteers than among the (older) aid workers. A disproportional risk for malaria, especially falciparum malaria, was detected in Africa. Further studies are necessary to investigate the behavior among young volunteers regarding the compliance with prevention and especially chemoprophylaxis for malaria as such measures are the key in reducing the occurrence for the most common tropical infections. Similar is the situation with the prevention of dengue, showing increasing numbers of cases worldwide and its potentially underestimated risk in India. Personal protective measures continue to be crucial. Using repellents like DEET, treating clothing with permethrin and sleeping under a mosquito net being the most effective (Anonymous 2021a). There is a need to address the region-specific risks more adequately in training seminars in order to raise awareness about existing health hazards associated with specific regions they will be visiting or staying, for the young volunteers to improve self-management skills before they travel abroad. Introducing a mandatory medical checkup after returning home will prove to be an important step to recognize illnesses early and to prevent later diseases with potentially severe outcomes.

Statements And Declarations

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Authors contributions

1. The preparation of the research project
2. The assembly of data for the research
3. The conducting of statistical analysis
4. Interpretation of results
5. Manuscript preparation
6. Literature review

Competing interests

The authors have declared no conflicts of interest.

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Tables

Table 1: Travel destinations for the service abroad among diagnosed volunteers / aid workers (n=457)

	Africa		Asia/ Oceania		Latin-America		Europe	
	n	%	n	%	n	%	n	%
volunteers	207	71	47	16	36	13	0	0
aid workers	112	67	41	24	13	8	1	1

Table 2: Appearance of tropical illnesses (n=457)

diseases	volunteers		aid workers	
	n	%	n	%
malaria	158	54.5	62	37.1
dengue	57	19.7	33	19.8
Typhoid fever	41	14.1	4	2.4
schistosomiasis	17	5.9	39	23.4
other	25	8.6	31	18.6

Table 3: Mandatory examinations

total collective (n=457)	volunteers n=290		aid worker n=167	
	n	%	n	%
Diagnosis made abroad	279	96.2	104	62.3
Made pre-travel examination	110	37.9	159	95.2
Made post-travel examination	66	22.8	143	85.6
Recommendation as recognized occupational tropical disease	188	64.8	106	63.5

Table 4: Recommended recognition rate as an occupational disease (n=457)

Disease	volunteers		aid workers	
	n	%	n	%
malaria	133	84.2	54	87.1
dengue	45	78.9	23	69.7
typhoid fever	4	9.8	1	25.0
schistosomiasis	3	17.6	17	43.6
other	9	36.0	13	41.9

Figures

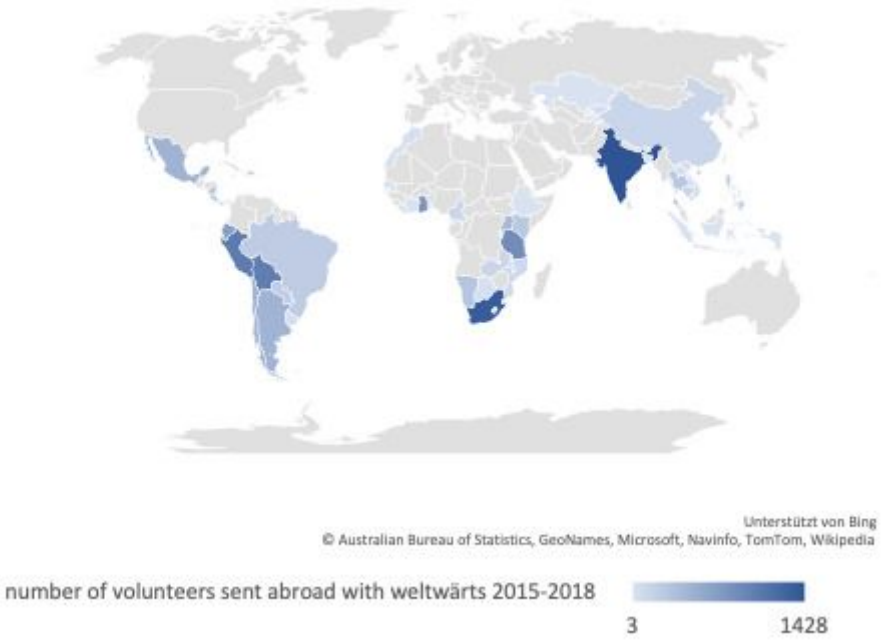

Figure 1

Volunteers sent abroad 2015-2018 (n=14.052)

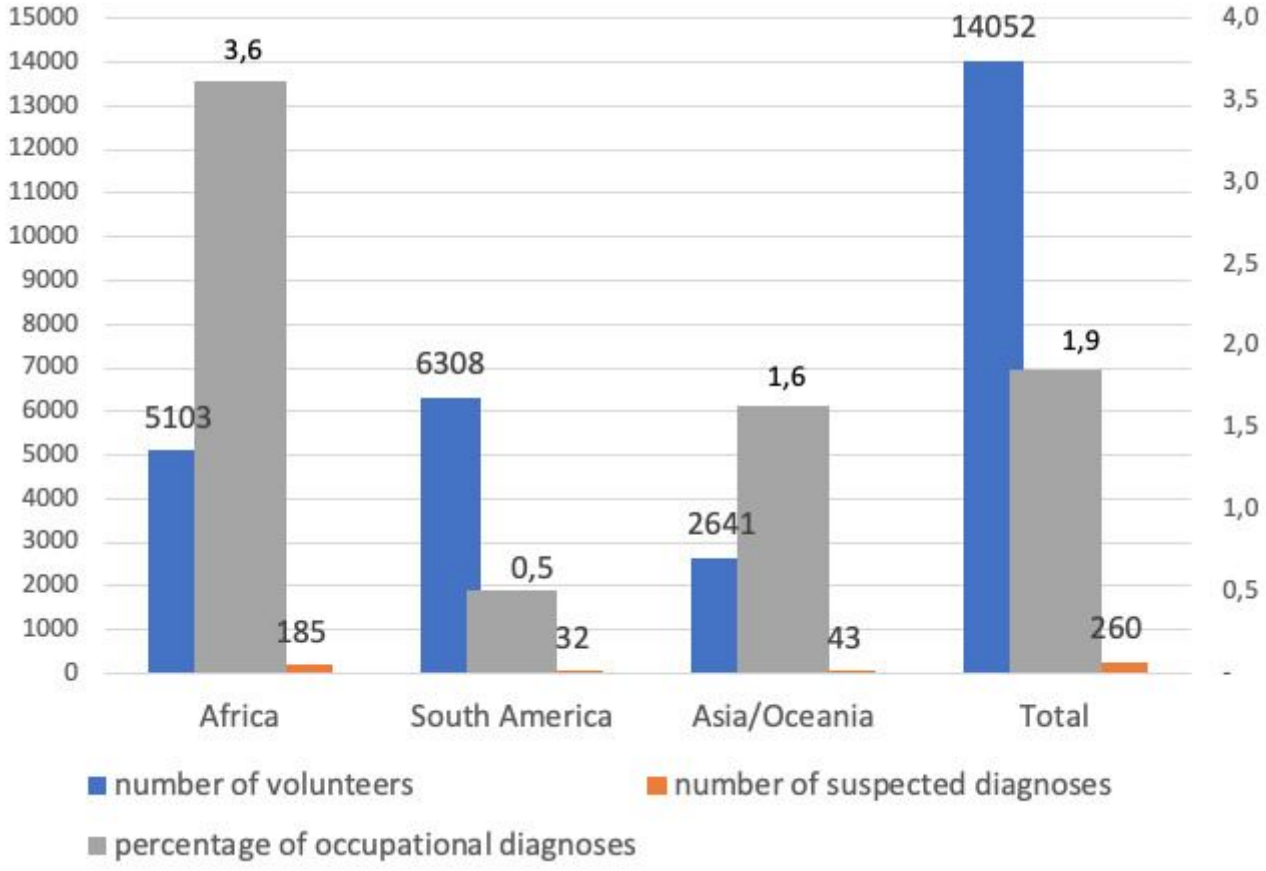

Figure 2

Diagnosed percentages for all volunteers sent abroad 2015-2018 (n=14.052) with the left y-axis showing the numbers of volunteers and the right y-axis the percentages of diagnoses

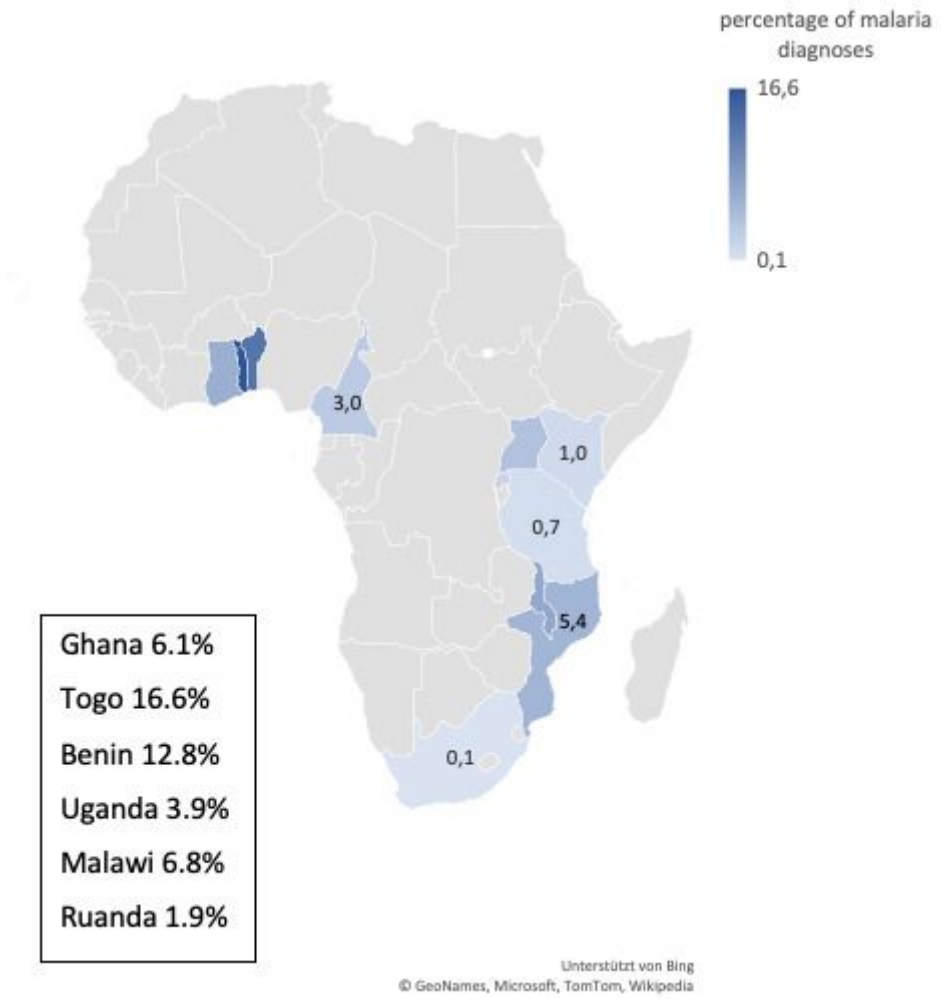

Figure 3

Distribution [%] of malaria cases among volunteers in Africa 2015-2018 (n= 140)

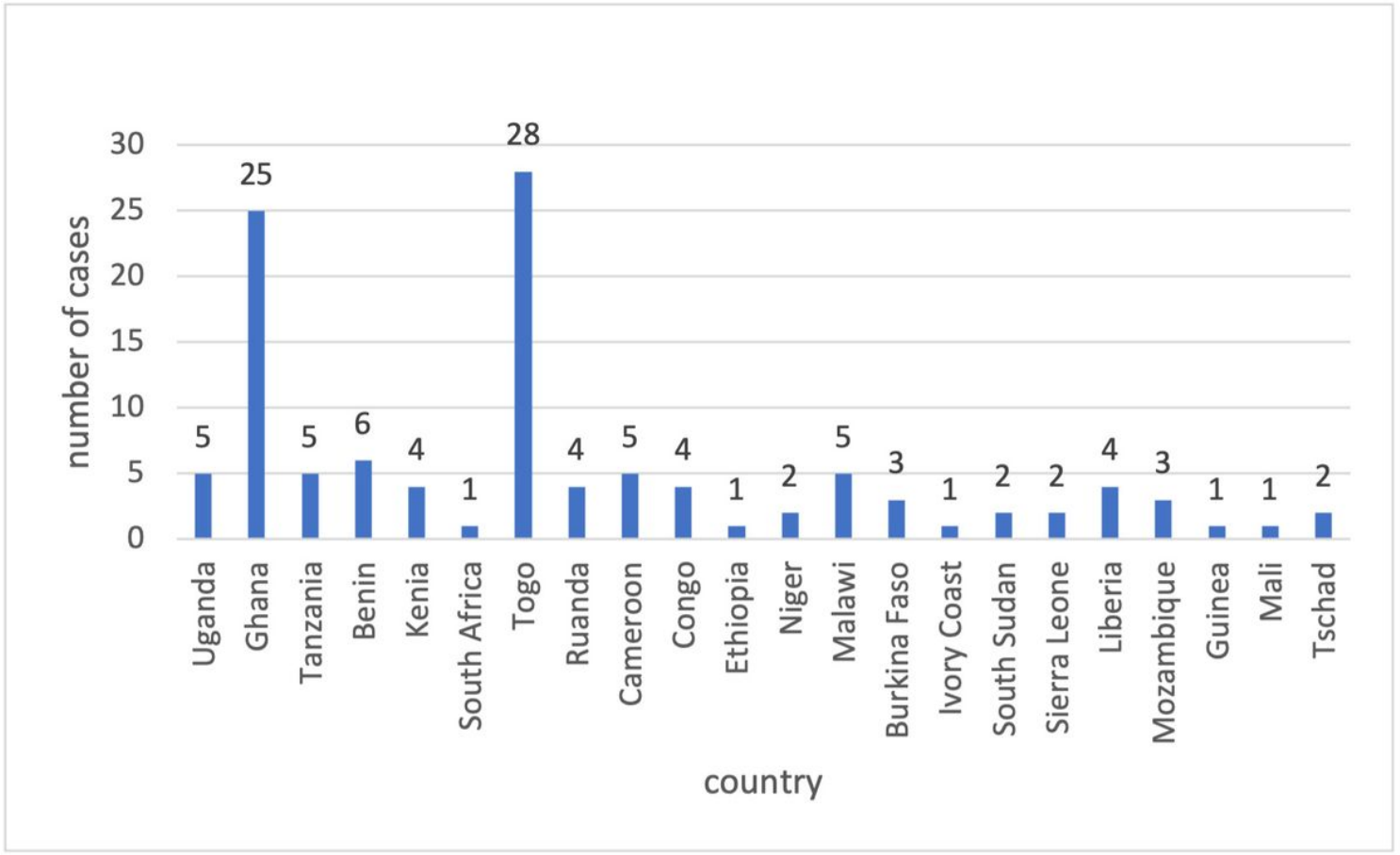

Figure 4

Frequency of proven falciparum malaria cases among volunteers in Africa (n=114)

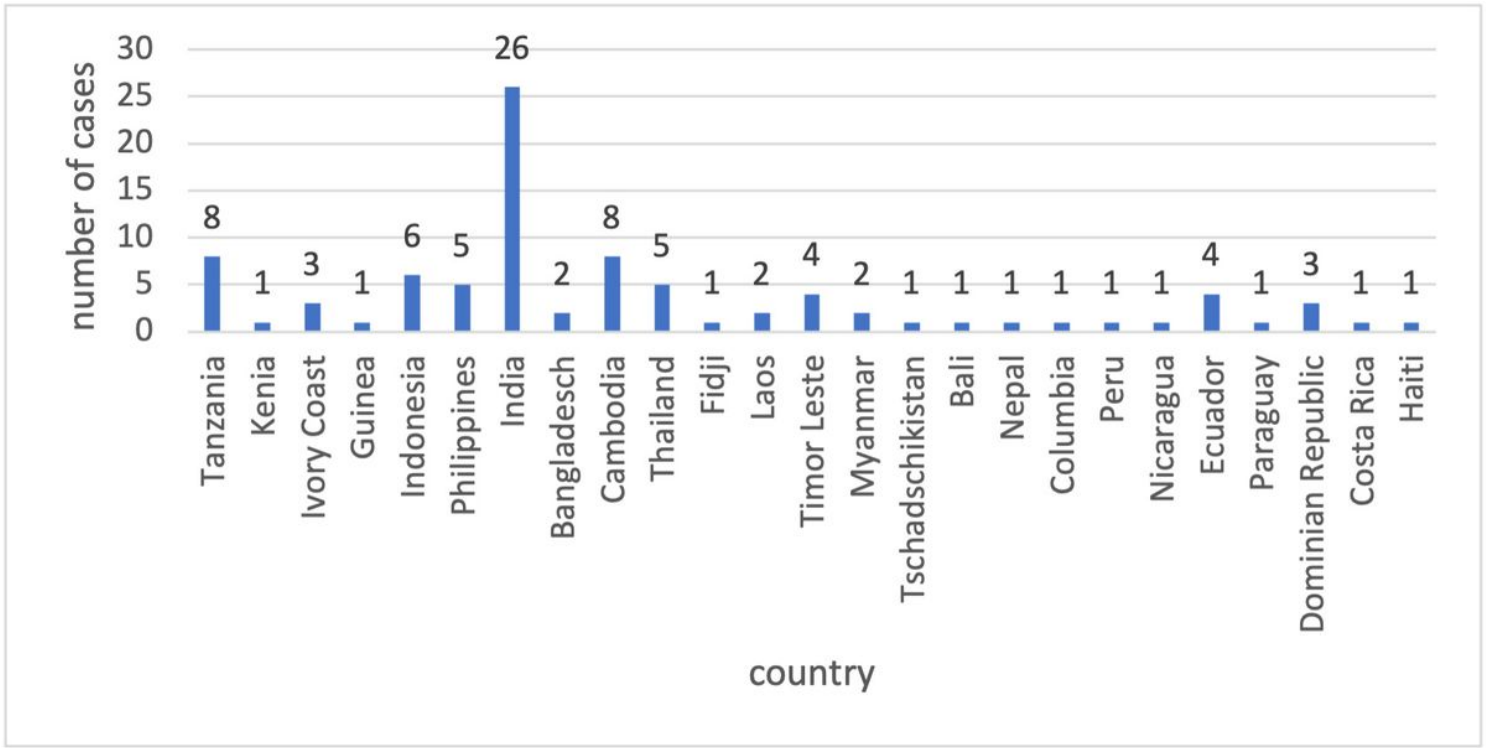

Figure 5

Frequency of dengue cases among volunteers and aid workers (n=90)