

Skin disorders among travellers returning from tropical and non-tropical countries consulting a travel medicine clinic

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Summary

OBJECTIVE To evaluate the causes and risks for imported skin disorders among travellers.

METHODS Data of 34 162 travellers returning from tropical and non-tropical countries and presenting at the outpatient travel medicine clinic of the University of Munich, Germany, between 1999 and 2009 were analyzed for this study. Of these, 12.2% were diagnosed with skin disorders.

RESULTS Main destinations visited were Asia (40%), Africa (27%) and Latin America (21%). Tourism in the form of adventure travel/backpacking (47%) and package holidays (23%) was the most common purpose of travel. The leading causes of skin disorders were arthropodal (23%), bacterial (22%), helminthic (11%), protozoan (6%), viral (6%), allergic (5%) and fungal (4%). The 10 most frequently diagnosed specific skin diseases associated with specific destinations were insect bites (17%, Southern Europe), cutaneous larva migrans (8%, Asia and Latin America), cutaneous leishmaniasis (2.4%, Mediterranean Region/Middle East), dengue fever (1.5%, Asia), rickettsioses (1.3%, Southern Africa), myiasis (0.8%, Central America), filarioses (0.7%, Africa), tick bites (0.6%, Central/Eastern Europe), schistosomiasis (0.6%, Africa) and tungiasis (0.6%, Africa). Travellers in sub-Saharan Africa had the highest relative risk of acquiring skin disorders.

CONCLUSION As more than 20% of all skin disorders among returned travellers were caused by arthropods and about 50% by infectious pathogens, pre-travel consultations should include specific prophylaxis and consider the most important risk factor for the travel destination.

keywords skin disorders, cutaneous symptoms, dermatoses, travel medicine, tropics, travel

Introduction

After diarrhoea and fever, skin disorders are the third most frequent health problem among returned travellers consulting travel medicine clinics (Hill 2000; Freedman *et al.* 2006; Fenner *et al.* 2007; Caumes *et al.* 2008; O'Brien 2009; Patel & Sethi 2009), accounting for more than 10% of all consultations (Harms *et al.* 2002; Caumes *et al.* 2008) at both travel clinics and non-specialized primary care centres (Caumes *et al.* 2008; O'Brien 2009). With a prevalence of 23%, skin disorders are the most frequent disease among travellers (Ansart *et al.* 2005).

The vast spectrum of skin disorders reflects the multitude of causative agents of both infectious and non-infectious aetiology (O'Brien 2009). The variety of ethnical backgrounds and travel habits of patients is no less diverse (O'Brien *et al.* 2006; Fenner *et al.* 2007; Chen *et al.* 2009). Similarly, skin disorders of patients returning from tropical

countries belong to a diverse spectrum of illnesses not only specific to tropical countries but also common worldwide (Hill 2000). Some illnesses considered as exotic are not only endemic to tropical or subtropical countries but also prevalent in certain industrialized countries, as in the case of cutaneous leishmaniasis (Lupi *et al.* 2009) and American trypanosomiasis (Patel & Sethi 2009). Because of increasing globalization and international travel, the incidence of tropical illnesses in industrialized countries has been rising (Reid & Cossar 1993), alerting physicians in the industrialized world to the necessity of understanding imported tropical diseases. Although specifically tropical diagnoses among dermatological syndromes have been declining (Monsel & Caumes 2008), acquired skin diseases remain important. They are one of the leading reasons for which patients seek medical help and for which non-febrile patients get hospitalized, as seen in Israel (Stienlauf *et al.* 2005) as well as in France, where up to 10% of dermatoses result in hospitalization (Caumes *et al.* 1995).

Finally, when considering tropical and subtropical diseases in general, dermatologic problems provide important

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information for diagnosing systemic infections, such as rickettsial infections, dengue fever and schistosomiasis, which also result in cutaneous manifestations (Lucchina *et al.* 1997; Ryan *et al.* 2002; Wilson & Chen 2004).

Many international studies on travel-related illnesses have been published. They offer a good overview of the main symptoms seen in patients, namely diarrhoea, fever, upper respiratory tract infections and skin problems (Ryan *et al.* 2002; Freedman *et al.* 2006; O'Brien *et al.* 2006; Caumes *et al.* 2008; Patel & Sethi 2009). In some of these studies, the latter is rarely thoroughly analyzed. Other studies have concentrated solely on specific dermatologic problems and offer excellent descriptions of certain cutaneous diagnoses frequently seen in travellers (Mahe 2001; Feldmeier 2008; Pincus *et al.* 2008; Charles 2009; Davis *et al.* 2009; Hay 2009). However, either these studies concentrate on single diseases and specific tropical regions visited, or the sample size was limited.

The present study analyzes the results of skin disorders among travellers returning from tropical and non-tropical countries who consulted the travel medicine clinic of the *Department of Infectious Diseases and Tropical Medicine* (DITM) of the Ludwig-Maximilians University of Munich, Germany, between 1999 and 2009. Thus, it offers an analysis of all skin disorders seen in a large number of returned travellers.

Methods

Study population

We analyzed the records of 34 162 returned travellers who presented at DITM between January 1999 and December 2009. Of these, 4158 (12.2%) were diagnosed with skin disorders (study population). Cases were defined as patients with skin disorders that appeared during or after travel in tropical and non-tropical countries. Diagnoses were mainly based on clinical examination, laboratory results and microscopic examination of skin biopsies. We analyzed demographic [sex, age and origin (country of birth)], travel (destination, duration and type of travel) and clinical data (causative agents resulting in skin disorders).

Estimated relative risk for travellers

The relative risk (RR) of skin disorders among returned travellers was estimated as follows: division of ratio 1 by ratio 2. Ratio 1 was calculated as follows: division of the number of cases with any skin disorder returning from a certain travel destination (in the numerator) by the number of air passengers flying from Germany to

the same travel destination (in the denominator) in the year 2008 [Federal Bureau of Statistics (Statistisches Bundesamt) 2008]. Ratio 2 was calculated as follows: division of the number of cases with any skin disorder returning from overseas (in the numerator) by the number of air passengers flying from Germany to overseas (in the denominator) in the year 2008 (Federal Bureau of Statistics (Statistisches Bundesamt) 2008) (Table 3).

Statistical analysis

Approximative tests (χ^2 -tests) as parametric tests were conducted using Stata software, version 9.0. (Stata Corporation, College Station, TX, USA) and EpiInfo, version 3.4.3 (Centers for Disease Control and Prevention, CDC, Atlanta, GA, USA). Significant differences were defined as *P*-values (*P*) below 0.05 or as not overlapping of 95 per cent confidence intervals (95% CI) of proportions.

Results

Demographic data

In the study population of 4158 cases, 2188 (52.6%) cases were women. The age range was 0–94 years, the mean age 38.7 years and the median age 37.4 years. Most cases (2177/4158: 52.4%) were in age group 20–39 years. Among travellers returning from industrialized countries, the proportion of those aged 60–94 years was 19.8%. This proportion was significantly ($P < 0.01$) higher than among those returning from Asia, Africa and Latin America. Most travellers (3610/4158: 86.8%) were of German origin (Germany as country of birth), followed by travellers of European (312: 7.5%) and African (98: 2.4%) origin. Travellers of European (except Germany), African, Asian, and Latin American origin significantly ($P < 0.01$ each) more frequently chose to travel to their own regions of birth (Table 1).

Travel data

In the study population of 4158 cases, the proportion of travellers staying abroad 1–15 days was 35.0% (1456/4158), whereby it was significantly ($P < 0.01$) higher among travellers returning from industrialized countries (302/516: 58.5%). The proportion of travellers staying abroad >30 days was significantly ($P < 0.01$) higher among those returning from Asia (538/1656: 32.5%), Africa (339/1108: 30.6%) and Latin America (303/878: 34.5%) (Table 1).

Table 1 Demographic and travel data of 4158 returned travellers presenting with skin disorders at the University of Munich

Variables	Travel destinations				Total (<i>n</i> = 4158)	<i>P</i> -value*
	IC (%) (<i>n</i> = 516)	AS (%) (<i>n</i> = 1656)	AF (%) (<i>n</i> = 1108)	LA (%) (<i>n</i> = 878)		
Sex: female	276 (53.5)	851 (51.4)	583 (52.6)	478 (54.4)	2188 (52.6)	0.51
Age						
Range (year)	0–89	0–94	0–89	0–79	0–94	n.a.
Mean (year)	42.6	38.2	39.3	36.6	38.7	n.a.
CI 95% of mean (year)	41.2–44.0	37.5–38.9	38.4–40.3	35.6–37.6	38.2–39.2	n.a.
Median (year)	40.8	36.0	37.3	34.3	37.4	n.a.
Age group						
<20 years	39 (7.6)	69 (4.2)	84 (7.6)	62 (7.1)	254 (6.1)	<0.01*
20–39 years	209 (40.5)	935 (56.5)	533 (48.1)	500 (56.9)	2177 (52.4)	<0.01*
40–59 years	166 (32.2)	501 (30.3)	346 (31.2)	237 (27.0)	1250 (30.1)	0.12
60–94 years	102 (19.8)	151 (9.1)	145 (13.1)	79 (9.0)	477 (11.5)	<0.01*
Origin						
Germany	446 (86.4)	1460 (88.2)	924 (83.4)	780 (88.8)	3610 (86.8)	<0.01*
Europe	59 (11.4)	125 (7.5)	72 (6.5)	56 (6.4)	312 (7.5)	<0.01*
Africa	0 (0)	3 (0.2)	93 (8.4)	2 (0.2)	98 (2.4)	<0.01*
Asia	5 (1.0)	49 (3.0)	7 (0.6)	2 (0.2)	63 (1.5)	<0.01*
Latin America	3 (0.6)	7 (0.4)	5 (0.5)	34 (3.9)	49 (1.2)	<0.01*
North America	2 (0.4)	11 (0.7)	6 (0.5)	4 (0.5)	23 (0.6)	0.85
Oceania	1 (0.2)	1 (0.1)	1 (0.1)	0 (0)	3 (0.1)	n.a.
Duration of travel						
1–15 days	302 (58.5)	446 (26.9)	427 (38.5)	281 (32.0)	1456 (35.0)	<0.01*
16–30 days	106 (20.5)	672 (40.6)	342 (30.9)	294 (33.5)	1414 (34.0)	<0.01*
>30 days	108 (20.9)	538 (32.5)	339 (30.6)	303 (34.5)	1288 (31.0)	<0.01*
Type of travel						
Adventure travel/backpack.	198 (38.4)	949 (57.3)	387 (34.9)	429 (48.9)	1963 (47.2)	<0.01*
Package holiday	163 (31.6)	317 (19.1)	287 (25.9)	193 (22.0)	960 (23.1)	<0.01*
VFR	67 (13.0)	132 (8.0)	169 (15.3)	110 (12.5)	478 (11.5)	<0.01*
Business trip	30 (5.8)	150 (9.1)	128 (11.6)	78 (8.9)	386 (9.3)	<0.01*
Other†	58 (11.2)	108 (6.5)	137 (12.4)	68 (7.7)	371 (8.9)	<0.01*

IC, Industrialized countries; Europe, North America and Oceania; AS, Asia; AF, Africa; LA, Latin America; n.a., not applicable; CI, confidence interval; backpack., backpacking; VFR, visiting friends and relatives.

**P*-value describes the association between demographic or travel data and travel destination. Significant *P*-values: defined as $P < 0.05$. No calculation if subgroup has small sample size of $n < 5$.

†Other: student exchange/scholarship, voluntary work, immigration, miscellaneous.

In the study population of 4158 cases, the most preferred types of travel were adventure travel/backpacking (1963: 47.2%); this proportion was significantly ($P < 0.01$) higher among travellers returning from Asia (949/1656: 57.3%). The proportion of travellers on package holidays was 23.1% (960); it was significantly ($P < 0.01$) higher among travellers returning from industrialized countries (163/516: 31.6%). The proportion of travellers visiting friends and relatives abroad was 11.5% (478); it was significantly ($P < 0.01$) higher among travellers returning from Africa (169/1108: 15.3%) (Table 1).

The 4158 cases with a travel-associated skin disorder had been visiting Asia (1656/4158: 39.8%), Africa (1108: 26.6%), Latin America (878: 21.1%) and industrialized

countries (516: 12.4%) situated in Western Europe (239: 5.7%), Oceania (113: 2.7%), Eastern Europe (105: 2.5%) and North America (59: 1.4%) (Table 1 and 3).

Arthropodal skin disorders

In the study population of 4158 cases, 275 dermatological diagnoses were documented. The leading category of causative agents that resulted in skin disorders was arthropods (938: 22.6%). The proportion of skin disorders caused by insects was 16.8% (697); it was significantly ($P < 0.01$) higher among travellers returning from industrialized countries (110/516: 21.3%), especially Southern Europe (67/202: 33.2%) (Table 2). Patients presenting

Table 2 Causes for travel-associated skin disorders among 4158 returned travellers presenting at the University of Munich

Category of causative agent Skin disease	Travel destinations				Total (%) (<i>n</i> = 4158)	<i>P</i> -value*
	IC (%) (<i>n</i> = 516)	AS (%) (<i>n</i> = 1656)	AF (%) (<i>n</i> = 1108)	LA (%) (<i>n</i> = 878)		
Arthropodal	152 (29.5)	347 (21.0)	204 (18.4)	235 (26.8)	938 (22.6)	<0.01*
Insects bites	110 (21.3)	282 (17.0)	151 (13.6)	154 (17.5)	697 (16.8)	<0.01*
Ectoparasitic	41 (7.9)	61 (3.7)	50 (4.5)	79 (9.0)	231 (5.6)	<0.01*
Scabies	13 (2.5)	36 (2.2)	26 (2.3)	20 (2.3)	95 (2.3)	0.97
Myiasis	0 (0)	0 (0)	8 (0.7)	24 (2.7)	32 (0.8)	<0.01*
Tick bites	13 (2.5)	4 (0.2)	6 (0.5)	3 (0.3)	26 (0.6)	<0.01*
Tungiasis	0 (0)	1 (0.1)	13 (1.2)	9 (1.0)	23 (0.6)	<0.01*
Bacterial	104 (20.2)	399 (24.1)	276 (24.9)	118 (13.4)	897 (21.6)	<0.01*
Rickettsioses	1 (0.2)	1 (0.1)	53 (4.8)	1 (0.1)	56 (1.3)	<0.01*
Helminthic	23 (4.5)	192 (11.6)	113 (10.2)	110 (12.5)	438 (10.5)	<0.01*
Cutaneous larva migrans	10 (1.9)	165 (10.0)	65 (5.9)	88 (10.0)	328 (7.9)	<0.01*
Filarioses	2 (0.4)	5 (0.3)	19 (1.7)	2 (0.2)	28 (0.7)	<0.01*
Schistosomiasis	2 (0.4)	4 (0.2)	14 (1.3)	4 (0.5)	24 (0.6)	<0.01*
Protozoan†	40 (7.8)	72 (4.3)	81 (7.3)	58 (6.6)	251 (6.0)	<0.01*
Cutaneous leishmaniasis	31 (6.0)	20 (1.2)	21 (1.9)	26 (3.0)	98 (2.4)	<0.01*
Viral	18 (3.5)	107 (6.5)	65 (5.9)	46 (5.2)	236 (5.7)	0.07
Dengue fever	2 (0.4)	41 (2.5)	4 (0.4)	14 (1.6)	61 (1.5)	<0.01*
Herpes	5 (1.0)	18 (1.1)	22 (2.0)	8 (0.9)	53 (1.3)	0.10
Allergic	39 (7.6)	90 (5.4)	50 (4.5)	47 (5.4)	226 (5.4)	0.09
Fungal	17 (3.3)	56 (3.4)	53 (4.8)	42 (4.8)	168 (4.0)	0.14
Autoimmune, rheumatic	8 (1.6)	13 (0.8)	14 (1.3)	12 (1.4)	47 (1.1)	0.36
Physical (injury, lesion)	6 (1.2)	15 (0.9)	13 (1.2)	7 (0.8)	41 (1.0)	0.80
Phototoxic	6 (1.2)	12 (0.7)	2 (0.2)	13 (1.5)	33 (0.8)	<0.01*
Maritime animals	7 (1.4)	9 (0.5)	6 (0.5)	8 (0.9)	30 (0.7)	0.21
Chemical, toxic	0 (0)	10 (0.6)	6 (0.5)	3 (0.3)	19 (0.5)	0.31
Terrestrial animals (bites)	3 (0.6)	8 (0.5)	1 (0.1)	3 (0.3)	15 (0.4)	0.30
Miscellaneous	19 (3.7)	52 (3.1)	45 (4.1)	25 (2.8)	141 (3.4)	0.36
Unknown	74 (14.3)	274 (16.5)	179 (16.1)	151 (17.2)	678 (16.3)	0.56

IC, Industrialized countries: Europe, North America and Oceania; AS, Asia; AF, Africa; LA, Latin America.

**P*-value describes the association between category of causative agent or skin disease and travel destination. Significant *P*-values: defined as $P < 0.05$.

†Among 4158 travellers with skin disorders, 60 cases of malaria and 36 cases of giardiasis were diagnosed in this study without any causative relation to skin disorders.

insect bites were significantly ($P < 0.01$ each) more common among women and package tourists who had been travelling for a short-term (<60 days) and were significantly ($P < 0.01$ each) less common among business travellers and among those returning from long-term trips (>30 days).

The proportion of skin disorders caused by ectoparasites was 5.6% (231/4158), and it was significantly ($P < 0.01$) higher among travellers returning from Latin America (79/878: 9.0%). The most frequently detected skin diseases caused by ectoparasites were scabies (95/4158: 2.3%), myiasis (32: 0.8%), tick bites (26: 0.6%) and tungiasis (23: 0.6%). The proportion of cases with myiasis was significantly ($P < 0.01$) higher among travellers returning from Latin America (24/878: 2.7%). The pro-

portion of cases with tick bites was significantly ($P < 0.01$) higher among travellers from Europe (13/516: 2.5%), especially Eastern Europe (8/105: 7.6%). The proportion of cases with tungiasis was significantly ($P < 0.01$) higher among travellers from Africa (13/1108: 1.2%) (Table 2). Skin manifestations owing to ectoparasites were significantly less prevalent among travellers who had been on a package holiday ($P = 0.03$).

Bacterial skin disorders

Eight hundred and ninety-seven cases (21.6%) with bacterial skin disorders were documented; 713 (17.1%) of whom had pyodermas. The proportion of rickettsiosis was 1.3% (56); it was significantly ($P < 0.01$) higher among travellers

Table 3 Relative Risk (RR) of different travel destinations for acquiring skin disorders among 4158 returned travellers presenting at the University of Munich

Travel destination Region Sub region	No. of cases with skin disorders (%) (<i>n</i> = 4158)	No. of air passengers (thousand)*	RR†
Europe	344 (8.3)	n.a.	n.a.
Overseas	3814 (91.7)	18 945	1.00
North America	59 (1.4)	6954	0.04
Oceania	113 (2.7)	309	1.82
Asia	1656 (39.8)	7248	1.13
Middle East	75 (1.8)	1855	0.20
North/Central Asia	7 (0.2)	324	0.11
South Asia	513 (12.3)	1133	2.25
South East Asia	1061 (25.5)	3936	1.34
Africa	1108 (26.6)	3556	1.55
North Africa	176 (4.2)	2423	0.36
West Africa	266 (6.4)	191	6.92
Central Africa	29 (0.7)	018	8.00
East Africa	285 (6.9)	290	4.88
Southern Africa	352 (8.5)	634	2.76
Latin America	878 (21.1)	1602	2.72
Central America	230 (5.5)	316	3.62
Caribbean	246 (5.9)	496	2.46
South America	402 (9.7)	790	2.53

n.a., not applicable because of unknown number of travel from Germany to other European countries via road or rail.

*Official total number of air passengers departing from Germany and flying overseas (outside of Europe) in 2008: 18.945 million (Statistisches Bundesamt, Federal Bureau of Statistics, Wiesbaden, Germany).

†The RR of skin disorders among returned travellers was estimated as follows: division of ratio 1 by ratio 2. Ratio 1 was calculated as follows: division of the number of cases with any skin disorder returning from a certain travel destination (in the numerator) by the number of air passengers flying from Germany to the same travel destination (in the denominator) in the years 2008 [Federal Bureau of Statistics (Statistisches Bundesamt) 2008]. Ratio 2 was calculated as follows: division of the number of cases with any skin disorder returning from overseas (in the numerator) by the number of air passengers flying from Germany to overseas (in the denominator) in the years 2008 [Federal Bureau of Statistics (Statistisches Bundesamt) 2008].

returning from Africa (53/1108: 4.8%), especially Southern Africa (49/352: 13.9%) (Table 2). These 53 travellers presented with eschars (inoculation of *Rickettsia africae* after tick bite). No significant correlation was found between bacterial skin diseases and demographic data.

Helminthic skin disorders

Most cases of helminthic skin disorders were caused by *Ancylostoma* spp. [causing cutaneous larva migrans

(CLM); 328/4158: 7.9%], *Filariae* spp. [28: 0.67%; mainly *Onchocerca volvulus* (10: 0.24%), *Mansonella perstans* (8: 0.19%), *Loa loa* (5: 0.12%)] and *Schistosoma* spp. [24: 0.58%, including cercarial dermatitis (swimmers' itch; 6: 0.14%) and Katayama syndrome (5: 0.12%)]. CLM was significantly ($P < 0.01$) more frequently diagnosed among travellers returning from Asia (165/1656: 10.0%) and from Latin America (88/878: 10.0%), and filarioses were significantly ($P < 0.01$) more frequently diagnosed among travellers returning from Africa (19/1108: 1.7%) (Table 2). CLM was significantly associated with young (aged 20–39 years) adults ($P < 0.01$) and backpackers ($P < 0.01$) who had been travelling for a short period (<60 days) ($P = 0.04$).

Protozoan skin disorders

The most frequently detected protozoan skin disease was cutaneous leishmaniasis (98/4158: 2.4%). Patients with cutaneous leishmaniasis were significantly ($P < 0.01$ each) more common among travellers returning from the Middle East (12/75: 16.0%) and from industrialized countries (31/516: 6.0%), mainly from the Mediterranean region (31/364: 8.5%). No significant correlation was found between cutaneous leishmaniasis and demographic data. Skin disorders were also found among malaria (60/4158: 1.4%) and giardiasis (36: 0.9%) patients by chance without aetiological relation to skin disorders (Table 2).

Viral skin disorders

The most frequently detected viral skin disease was dengue fever (61/4158: 1.5%). Patients with dengue fever were significantly ($P < 0.01$ each) more frequent among travellers returning from Asia (41/1656: 2.5%) and among young travellers (age 20–39 years). The proportion of herpes in the study population was 1.3% (53/4158); it was not significantly ($P = 0.10$) associated with a particular region (Table 2).

Other skin disorders

Other causes for skin disorders among returned travellers were allergic (226/4158: 5.4%), fungal (168: 4.0%), including 15 cases of pityriasis versicolor), autoimmune/rheumatic (47: 1.1%), physical (injury, lesion; 41: 1.0%) and phototoxic (33: 0.8%). The proportion of phototoxic skin diseases was significantly ($P < 0.01$) more frequently diagnosed among travellers returning from Latin America (Table 2). No significant correlation

was found between these skin diseases and demographic data.

Relative risk for acquiring skin disorders

The highest RR for acquiring skin disorders was found among travellers returning from Central Africa (RR = 8.00), West Africa (6.92) and East Africa (4.88). Nevertheless, the region with the highest RR was Latin America (RR = 2.72), especially Central America (RR = 3.62) (Table 3).

Discussion

This is a large study on imported skin disorders seen in 4158 travellers returning to Germany from tropical and non-tropical countries that analyzed demographic, travel and clinical data. The largest international study on this topic was published by GeoSentinel Surveillance Network (GSN), comprising data from 4589 patients (Lederman *et al.* 2008).

In the present study, arthropods, especially insects, caused most skin disorders as shown by Freedman *et al.* (2006), resulting in almost a quarter of all cases. The proportion of travellers with skin disorders caused by insects was significantly higher among those travelling for a short time and among package tourists. These correlations were confounded by destination, as the majority of people travelling from Germany to Southern Europe were short time travellers and package tourists.

About 6% of skin disorders were caused by ectoparasites, inducing scabies, myiasis, tick bites and tungiasis. This proportion was smaller than that in a French study (Caumes *et al.* 1995): Among travellers presenting at a travel medicine clinic in Paris, myiasis accounted for 9% of dermatoses and tungiasis for 6%, supposing that these patients had been travelling mostly in francophone countries in West or Central Africa, where the risk for these skin disorders is high. In the present study, the proportion of travellers with tungiasis was significantly higher among those returning from Africa; it was significantly higher for both myiasis among those returning from Latin America, especially Central America, and tick bites, among those returning from Central/Eastern Europe. As expected, travellers with the lowest risk for acquiring ectoparasitic skin diseases were package holiday tourists, because of better hygienic conditions during travel.

Confirming previous work (Lucchina *et al.* 1997; O'Brien 2009), we found that diseases of infectious aetiology accounted for the majority of all diagnoses. Bacteria caused about 22% of all skin diseases in returning travellers, mainly gram-positive bacterial skin infections as

primary infections or secondary ones after insect bites and wounds (Mahe 2001). These are slightly higher figures than observed by Caumes *et al.* (1995) and Lederman *et al.* (2008).

Rickettsial infections cover the majority of skin diseases acquired in Southern Africa (Wilson & Chen 2004; Lederman *et al.* 2008; O'Brien 2009). In this study, *Rickettsia* spp. caused about 14% of all skin disorders seen in patients returning from South Africa.

Similarly, findings for helminthic skin diseases mostly coincided with results stated by previous publications. In our study, CLMs was the most frequently diagnosed helminthic skin disease (8%) as shown in other studies (Caumes *et al.* 1995; Wilson & Chen 2004; Freedman *et al.* 2006; Lederman *et al.* 2008; O'Brien 2009; Patel & Sethi 2009). Patients with CLM were significantly more common among travellers returning from Latin America, especially from the Caribbean region, as described in other studies (Kain 1999; Tremblay *et al.* 2000; Harms *et al.* 2002; Freedman *et al.* 2006; O'Brien 2009), but it was also significantly high among those returning from Asia. Young backpackers (aged 20–39), who had been travelling for a short period (<60 days), had a higher risk to acquire CLM.

Filarial diseases were significantly associated with long-term journeys (>365 days), but this correlation was confounded by destination. A large number of travellers of African origin had been visiting friends and relatives for a longer period of time. As shown in the present study, travelling in Africa, especially West Africa, is highly correlated with the acquisition of filarioses as described before (Wilson & Chen 2004; Freedman *et al.* 2006).

In our study, the proportion of cutaneous leishmaniasis was significantly higher among travellers returning from the Mediterranean region (mainly Italy, Spain, and Malta) and the Middle East, where this disease is endemic. This finding can hardly be compared with those of other studies (Stienlauf *et al.* 2005; Freedman *et al.* 2006; Hengge & Marini 2008; Lederman *et al.* 2008; Zeegelaar & Faber 2008), in which more subjects had been travelling to Latin America than to the Mediterranean region. Consequently, more cases of cutaneous (partially mucocutaneous form was included) leishmaniasis were found in these studies among travellers from Latin America. As described before, cutaneous leishmaniasis has been shown to appear more frequently among young male travellers (Stienlauf *et al.* 2005; Hengge & Marini 2008; Lederman *et al.* 2008; Schlagenhauf *et al.* 2010) and long-term travellers (Chen *et al.* 2009). In the present study, no significant correlation between cutaneous leishmaniasis and sex, age, duration or type of travel was found. The only risk factor highly correlating with the risk to acquire cutaneous leishmaniasis was the travel destination.

The most frequent viral skin disease evaluated in this study was dengue fever. The proportion of dengue fever was significantly higher among travellers returning from Asia, especially from South East Asia, as found in other studies (Lupi & Tying 2003; Stienlauf *et al.* 2005). For other frequently imported skin diseases, such as herpes, allergic diseases and fungal diseases, no significant correlation to any travel destination was found. The frequencies of allergic and fungal skin diseases among travellers are comparable with those found in previous publications: 5.5% for allergic reactions; mycoses range between 2% and 6% (Caumes *et al.* 1995; Ansart *et al.* 2005, 2007; Freedman *et al.* 2006; O'Brien *et al.* 2006; Lederman *et al.* 2008).

Travel destination was the variable that highly correlated with the majority of imported skin disorders. The highest total risk of acquiring skin disorders during travel was for travellers departing from Germany and flying to Central, West, and East Africa, followed by Central America. Travellers in Africa had a significantly elevated risk of acquiring tungiasis, bacterial skin diseases, especially rickettsioses, and helminthic skin diseases such as filarioses and schistosomiasis. Travellers in Latin America had an elevated risk of ectoparasitic skin diseases, especially myiasis, and helminthic skin diseases, especially CLMs. Travellers in Asia had an elevated risk for bacterial and helminthic skin diseases, especially CLMs, and dengue fever. Among travellers in Southern Europe, this risk was significantly elevated for insect bites, among travellers in the Mediterranean Region/Middle East for cutaneous leishmaniasis and among travellers in Central/Eastern Europe for tick bites.

Our study had some limitations. The majority of skin diseases were diagnosed by the clinicians' opinion and not by laboratory examination of skin, blood or other samples, considering that precise diagnosis of several skin diseases is restricted to a classical clinical presentation and exposure history (Freedman *et al.* 2006). Mortality and hospitalization rates are unknown, for which reason no comparison could be made with results stated in other studies regarding these topics (Caumes *et al.* 1995; Stienlauf *et al.* 2005). Among travellers suffering from frequent infectious diseases such as malaria and giardiasis, many cases with skin disorders were found in the present study by chance, taking into account that no skin manifestations are caused by these infectious diseases.

In this study, more than 20% of all skin disorders among returned travellers were caused by arthropods, mainly insects. In addition, this increases the risk of secondary bacterial skin and soft tissue infections. Furthermore, about 50% of all skin disorders among returned travellers were caused by infectious pathogens, mainly bacteria and

helminths. Consequently, pre-travel consultations should include advice on specific prophylactic measures that focus on preventing insect bites and contact with infectious pathogens, while taking into consideration the intended destination of the traveller, as destination seems to be the most important risk factor for most imported skin diseases.

Acknowledgements

The authors thank all patients in this study for their cooperation.

Note

The GSN has published data on skin disorders among returned travellers by Lederman *et al.* (2008). In this publication, data of 4594 patients who presented at 31 globally dispersed physician-based travel/tropical medicine clinics between January 1997 and February 2006 were analyzed. As the *Department of Infectious Diseases and Tropical Medicine (DITM)* of the Ludwig-Maximilians University Munich is member of the GSN, a very small part of the presented data, which were collected from January 1999 through December 2009, have already been published by Lederman *et al.* (2008).

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