Illness in Children After International Travel: Analysis From the GeoSentinel Surveillance Network

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Illness in Children After International Travel: Analysis From the GeoSentinel Surveillance Network

WHAT'S KNOWN ON THIS SUBJECT: Children now routinely travel internationally. It has been suggested that significant proportions of such children develop travel-related illnesses. Previous studies on pediatric travel-related morbidities were from single centers or focused on specific diseases.

WHAT THIS STUDY ADDS: This study offers the first systematic evaluation of the demographic characteristics, health care use, and travel-related morbidities of children after international travel. Profiles of relative likelihoods of travel-related diseases, stratified according to region of travel and age group, are presented.

abstract

OBJECTIVE: By using a large, multicenter database, we investigated the characteristics and morbidities of 1591 children returning from 218 global destinations and presenting for care in 19 countries.

METHODS: Data reported to the GeoSentinel Surveillance Network between January 1997 and November 2007 were analyzed, to assess demographic features, travel characteristics, and clinical diagnoses of ill pediatric travelers. Data were compared between children and adults and among 3 pediatric age groups (0–5 years, 6–11 years, and 12–17 years).

RESULTS: Children were predominantly tourist travelers returning from Asia, sub-Saharan Africa, or Latin America. Compared with adults, children disproportionately presented within 7 days after return, required hospitalization, lacked pretravel health advice, and had traveled for the purpose of visiting friends and relatives. Diarrhea (28%), dermatologic conditions (25%), systemic febrile illnesses (23%), and respiratory disorders (11%) accounted for the majority of diagnoses reported for children. No fatalities were reported. Diarrhea occurred disproportionately among children after exposure to the Middle East/North Africa, dermatologic conditions after exposure to Latin America, systemic febrile illnesses after exposure to sub-Saharan Africa or Asia, and respiratory disorders after exposure to Europe or North America. The proportionate morbidity rates of travel-associated diseases differed among the pediatric age groups and between children and adults.


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KEY WORDS
child, travel, morbidity, prevention

ABBREVIATIONS
aOR—adjusted odds ratio
CI—confidence interval
CLM—cutaneous larva migrans
VFR—visiting friends and relatives

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According to the United Nations World Tourism Organization, there were >900 million international tourist trips in 2008. Although estimates of the number of children traveling internationally are limited, travel data for US residents in 2000 indicated that 7% of travelers (1.9 million travelers) were children. Tourism is the major reason for travel but, as a result of growing global migration, children often accompany caregivers on trips visiting friends and relatives (VFR) abroad.

Although children represent a significant proportion of the traveling public, little information is available regarding health problems of children traveling internationally. Most published literature on pediatric travel-related morbidity originated from single-center studies that reported only on hospitalized patients or focused on specific diseases (eg, malaria). This study reports clinical and epidemiological characteristics of 1591 children who were ill after international travel and sought medical care at a GeoSentinel Surveillance Network clinic. This study offers the first systematic evaluation of the demographic characteristics, health care use, and travel-related morbidities of children after international travel.

METHODS

GeoSentinel Surveillance Network

GeoSentinel sites are specialized travel and tropical medicine clinics on 6 continents that systematically contribute clinical information on all ill returning travelers, as described elsewhere.

Data Collection

To be eligible for inclusion in the GeoSentinel database, patients must have crossed an international border within 10 years and be seeking medical advice at a GeoSentinel clinic for a presumed travel-related condition.

Anonymous surveillance data are reported by the sites and entered into a structured query language database. Final diagnoses reported by physicians are assigned specific diagnosis codes from a standardized list of >500 diagnoses. These diagnoses are grouped into 21 broad syndrome categories.

Data entered into the GeoSentinel database from January 1, 1997, through November 30, 2007, were reviewed. Only ill pediatric travelers (<18 years of age) seen after travel, with either laboratory-confirmed or probable diagnoses, were included in the analysis. Ill returning adult travelers seen during the study period represented the comparison control group. Individuals who had traveled for the purpose of immigration or had undergone assessment during travel were excluded.

Statistical Analyses

The relative frequencies of group diagnoses and certain specific diagnoses (where feasible) and their associations with patient demographic and travel characteristics were analyzed by using SPSS 16.0 (SPSS Inc, Chicago, IL). Age group-specific proportionate morbidity was calculated as the number of patients with a specific or group diagnosis as a proportion of all ill returning patients in the respective age group. Data were compared among 3 pediatric age groups (0–5 years, 6–11 years, and 12–17 years), as well as between all children and all adults. The chi² test or Fisher’s exact test was used to test bivariate associations between categorical variables, and analysis of variance was used for continuous variables. In analyses of morbidity outcomes, multivariate logistic regression was used to adjust for potential confounding factors, with results presented in terms of adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs). Statistical significance was set at a 2-sided P value of <.05.

RESULTS

Demographic and Travel-Related Characteristics

During the study period, 1840 pediatric patients and 37,791 adult patients presented to a GeoSentinel site after international travel. Only patients with available probable or confirmed diagnoses (1581 children [87%] and 32,668 adults [86%]) were included in this study (Table 1).

The 3 most common world regions visited were Asia, sub-Saharan Africa, and Latin America, for both children and adults. A greater proportion of ill adults than children had returned from Asia. In contrast, more ill children presented after travel to Europe and the Middle East/North Africa. Although tourism was the most common reason for travel among children and adults, children were more likely than adults to be VFR travelers. In addition, among children, VFR travel was inversely associated with age.

Overall, children presented earlier than adults, required hospitalization more often, had shorter duration of travel, and were less likely to have received pretravel medical advice. In comparisons of the 3 pediatric age groups, younger children were more likely than older children to present sooner after return and to have had longer travel duration. The proportions of children who had received pretravel medical advice did not differ among the age groups. However, VFR pediatric travelers were less likely to have received pretravel advice than were non–VFR pediatric travelers (32% vs 51%; P < .001).

Travel-Associated Diagnoses Among Children

Overall Findings

Approximately 86% of all diagnoses of children presenting to GeoSentinel clinics fell into 4 major syndrome cat-
TABLE 1 Demographic Characteristics of Ill Pediatric and Adult Travelers Presenting After Travel

<table>
<thead>
<tr>
<th>Variable*</th>
<th>0–5 y (N = 528)</th>
<th>6–11 y (N = 410)</th>
<th>12–17 y (N = 653)</th>
<th>All Children (N = 1591)</th>
<th>All Adults (N = 32 668)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD, y</td>
<td>2.6 ± 1.5</td>
<td>8.3 ± 1.7</td>
<td>15.0 ± 1.7</td>
<td>9.2 ± 5.5</td>
<td>38.0 ± 14.0</td>
<td>&lt;.05*</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>284 (54)</td>
<td>223 (55)</td>
<td>313 (49)</td>
<td>820 (52)</td>
<td>16 552 (51)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Pretravel medical advice, n (%)</td>
<td>184 (50)</td>
<td>144 (49)</td>
<td>238 (48)</td>
<td>566 (49)</td>
<td>15 988 (58)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Hospitalization, n (%)</td>
<td>83 (16)</td>
<td>45 (11)</td>
<td>86 (14)</td>
<td>214 (14)</td>
<td>3318 (10)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Time from travel to presentation of ≤1 wk, n (%)</td>
<td>210 (45)</td>
<td>160 (46)</td>
<td>189 (34)</td>
<td>559 (41)</td>
<td>3155 (34)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Travel duration of &gt;30 d, n (%)</td>
<td>194 (41)</td>
<td>132 (37)</td>
<td>138 (25)</td>
<td>464 (33)</td>
<td>10 017 (36)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Destination, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asia</td>
<td>135 (28)</td>
<td>107 (28)</td>
<td>166 (27)</td>
<td>408 (27)</td>
<td>10 954 (36)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>147 (29)</td>
<td>86 (23)</td>
<td>152 (24)</td>
<td>385 (25)</td>
<td>7708 (26)</td>
<td></td>
</tr>
<tr>
<td>Latin America</td>
<td>92 (18)</td>
<td>87 (23)</td>
<td>163 (26)</td>
<td>342 (23)</td>
<td>7065 (23)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Europe</td>
<td>78 (15)</td>
<td>50 (13)</td>
<td>61 (10)</td>
<td>189 (13)</td>
<td>1564 (5)</td>
<td>&lt;.05*</td>
</tr>
<tr>
<td>Middle East/North Africa</td>
<td>47 (9)</td>
<td>43 (11)</td>
<td>58 (9)</td>
<td>148 (10)</td>
<td>1975 (7)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Oceania</td>
<td>9 (2)</td>
<td>3 (1)</td>
<td>18 (3)</td>
<td>30 (2)</td>
<td>561 (2)</td>
<td></td>
</tr>
<tr>
<td>North America</td>
<td>3 (1)</td>
<td>5 (1)</td>
<td>5 (1)</td>
<td>13 (1)</td>
<td>303 (1)</td>
<td></td>
</tr>
<tr>
<td>Reason for travel, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourism</td>
<td>351 (67)</td>
<td>263 (69)</td>
<td>434 (67)</td>
<td>1068 (68)</td>
<td>20 758 (64)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>VFR</td>
<td>121 (23)</td>
<td>79 (19)</td>
<td>75 (12)</td>
<td>276 (17)</td>
<td>3555 (10)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Business*</td>
<td>44 (8)</td>
<td>31 (8)</td>
<td>34 (5)</td>
<td>108 (7)</td>
<td>4617 (14)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Missionary/volunteer*</td>
<td>9 (2)</td>
<td>14 (3)</td>
<td>77 (12)</td>
<td>100 (6)</td>
<td>3280 (10)</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Student</td>
<td>0 (0)</td>
<td>2 (1)</td>
<td>24 (4)</td>
<td>26 (2)</td>
<td>488 (2)</td>
<td>&lt;.01*</td>
</tr>
</tbody>
</table>

Data are for patients who presented after travel exposure in 218 countries to GeoSentinel sites located in 19 different countries, as follows: Europe, 48%; United States/Canada, 31%; Asia, 11%; Israel, 4%; Australia/New Zealand, 4%; other sites, 2%. 

*Missing data were as follows: gender, 13 children and 356 adults; pretravel advice, 429 children and 5482 adults; inpatient treatment, 31 children and 875 adults; time from travel to clinic presentation, 230 children and 5840 adults; travel duration, 205 children and 5027 adults; destination, 76 children and 2538 adults; reason for travel, 13 children and 172 adults. 

*Test for trend among pediatric age groups.

*Comparison between all children and adults.

*Comparison among pediatric age groups.

*Children with reported business or missionary/volunteer travel represent children who accompanied their caregivers on business or missionary/volunteer travel.

egories, with diarrheal syndrome (28%) being the most common, followed by dermatologic disorders (25%), systemic febrile illnesses (23%), and respiratory disorders (11%) (Table 2). Vaccine-preventable infections accounted for 38 diagnoses (2%). No fatalities were reported during the study period.

Diarrheal Syndrome

Diarrhea in 449 children was classified as acute (80%) or chronic (duration of >2 weeks) (20%). Among 357 children with acute diarrhea, gastroenteritis without any identified pathogen (28%), bacterial diarrhea (29%), and parasitic diarrhea (25%) were the most common specific diagnoses.

Dermatologic Disorders

The 3 most common specific diagnoses among 390 children with dermatologic diagnoses were animal bites (24%), cutaneous larva migrans (CLM) (17%), and insect bites (12%). Dog bites (n = 49 [52%]) were the most frequent animal bites, followed by cat bites (n = 19 [20%]) and monkey bites (n = 18 [19%]). Almost all children (97%) who presented with animal bites received rabies postexposure prophylaxis.

Systemic Febrile Illnesses

Malaria was the most common specific cause (35%), followed by viral syndromes (28%) and unspecified febrile illnesses (11%), among children with systemic febrile illnesses (n = 358). Uncomplicated dengue fever and enteric fever accounted for only 6% each.

Respiratory Syndromes

Upper respiratory tract infections (38%), hyperactive airway disease (20%), and acute otitis media (17%) accounted for the majority of the 167 cases of respiratory syndrome.

Comparison of Travel-Associated Diagnoses Between Children and Adults

In comparison with adults, children had higher proportionate morbidity rates of any dermatologic syndrome, animal bites, CLM, and respiratory disorders (Fig 1). In contrast, adults had a significantly higher proportionate morbidity rate of non diarrheal gastrointestinal disorder. Although the proportionate morbidity rates for any diarrheal disorder, acute parasitic diarrhea, and chronic diarrhea were greater among adults, children were at higher risk for acute bacterial diarrhea and acute unspecified gastroenteritis. The proportionate morbidity rates for systemic febrile illnesses, including malaria and viral syndromes, did not differ between children and adults.
Risk Factor Analysis for Travel-Associated Diagnoses Among Children

Young children had higher proportionate morbidity rates for the broad diagnostic categories of diarrhea, dermatologic disorders, and respiratory disorders. They also had higher proportionate morbidity rates for more-specific diagnoses such as acute diarrhea, acute gastroenteritis, and upper respiratory tract infections (Fig 2). In the multivariate analysis, young age was associated independently with significantly higher proportionate morbidity rates for diarrhea and respiratory disorders, whereas advancing pediatric age was associated with a higher proportionate morbidity rate for systemic febrile illnesses (Table 3). Girls tended toward higher proportionate morbidity rates for diarrhea disorders overall, but results reached statistical significance only for acute diarrhea (aOR: 1.43 [95% CI: 1.10–1.87]). In contrast, boys had a higher proportionate morbidity rate for systemic febrile illnesses. Compared with shorter trips, prolonged travel (>30 days) increased the odds of a diagnosis of systemic febrile illness and reduced the odds of diarrheal disorders. Tourist or VFR travel was associated with a significantly greater risk of a systemic febrile illness, compared with all other categories of travel (ie, business, missionary, volunteer, or student travel). In contrast, tourist travelers were less likely to acquire a respiratory disorder. Prolonged travel (>30 days) (aOR: 4.19 [95% CI: 2.72–6.47]) and VFR travel (aOR: 2.18 [95% CI: 1.05–4.52]) were significantly associated with malaria, whereas gender and age did not influence the proportionate morbidity rates.

Geographic Variations in Travel-Associated Diagnoses Among Children

Overall, the prevailing disease categories differed importantly according to regions of exposure (Fig 3). In the multivariate analysis (Table 3), significant destination-specific associations were observed when travel to Europe or North America was used as the reference. Dermatologic diagnoses were twice as common after exposure in Latin America. Travel to the Middle East/North Africa was associated with a greater risk of diarrheal disorder (Table 3). Travel to sub-Saharan Africa

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**TABLE 2** Diagnostic Syndrome Groups, Selected Specific Diagnoses, and Rates of Hospitalization for 1581 Ill Returning Pediatric Travelers

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Pediatric Travelers, n (%)</th>
<th>Proportion of Children Hospitalized, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrheal disorders, all</td>
<td>449 (28)</td>
<td>7</td>
</tr>
<tr>
<td>Acute diarrhea</td>
<td>357 (22)</td>
<td>8</td>
</tr>
<tr>
<td>Bacterial cause</td>
<td>104 (7)</td>
<td>12</td>
</tr>
<tr>
<td>Gastroenteritis, unspecified</td>
<td>98 (6)</td>
<td>10</td>
</tr>
<tr>
<td>Parasitic cause</td>
<td>88 (6)</td>
<td>2</td>
</tr>
<tr>
<td>Chronic diarrhea</td>
<td>92 (6)</td>
<td>4</td>
</tr>
<tr>
<td>Dermatologic disorders, all+</td>
<td>390 (25)</td>
<td>4</td>
</tr>
<tr>
<td>Animal bites</td>
<td>95 (6)</td>
<td>2</td>
</tr>
<tr>
<td>CLM</td>
<td>66 (4)</td>
<td>2</td>
</tr>
<tr>
<td>Insect bites</td>
<td>46 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Systemic febrile illnesses, all+</td>
<td>338 (23)</td>
<td>36</td>
</tr>
<tr>
<td>Malaria</td>
<td>124 (8)</td>
<td>69</td>
</tr>
<tr>
<td>Viral syndromes</td>
<td>99 (6)</td>
<td>1</td>
</tr>
<tr>
<td>Febrile illnesses, unspecified</td>
<td>40 (3)</td>
<td>8</td>
</tr>
<tr>
<td>Dengue fever</td>
<td>25 (2)</td>
<td>39</td>
</tr>
<tr>
<td>Enteric fever</td>
<td>21 (1)</td>
<td>60</td>
</tr>
<tr>
<td>Respiratory disorders</td>
<td>167 (11)</td>
<td>15</td>
</tr>
<tr>
<td>Upper respiratory tract infections</td>
<td>64 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Acute otitis media</td>
<td>26 (2)</td>
<td>4</td>
</tr>
<tr>
<td>Nondiarrheal gastrointestinal disorders+</td>
<td>114 (7)</td>
<td>22</td>
</tr>
<tr>
<td>Non-specific symptoms</td>
<td>70 (4)</td>
<td>20</td>
</tr>
<tr>
<td>Dental problems</td>
<td>34 (2)</td>
<td>0</td>
</tr>
<tr>
<td>Tissue parasites</td>
<td>30 (2)</td>
<td>14</td>
</tr>
<tr>
<td>Genitourinary disorders+</td>
<td>24 (2)</td>
<td>13</td>
</tr>
<tr>
<td>Injuries</td>
<td>21 (1)</td>
<td>5</td>
</tr>
<tr>
<td>All children</td>
<td>1581 (100)</td>
<td>14</td>
</tr>
</tbody>
</table>

Columns do not add up to 100% because patients could have >1 diagnosis. Only syndromes that constituted >1% of all diagnoses among children and the most frequently observed specific diagnoses of the top 4 broad syndrome groups were considered for analysis. Vaccine-preventable infections were mostly infections with Salmonella typhi (n = 14 [37%]), hepatitis A virus (n = 13 [34%]), and varicella zoster virus (n = 5 [13%]).

a The most common bacterial pathogens identified in acute diarrhea were Campylobacter spp (n = 26 [25%]) and Salmonella spp (n = 25 [24%]).

b Giardia spp (n = 45 [47%]) was the parasite identified most frequently.

c Postinfectious irritable bowel syndrome (n = 25 [27%]) was the most common specific diagnostic entity among children with chronic diarrhea.

d Bacterial skin infections (skin abscesses or impetigo; n = 33 [9%]), fungal skin infections (n = 21 [5%]), allergic skin rashes (n = 19 [5%]), and cutaneous leishmaniasis (n = 18 [4%]) were less frequently diagnosed conditions.

e Less common conditions were mononucleosis syndrome infection with Epstein-Barr virus, cytomegalovirus, or Toxoplasma gondii; n = 14 [4%]; and rickettsial infections (n = 5 [1%]; Rickettsia africae, n = 3; unidentified Rickettsia spp, n = 2); all infections with R. africae were acquired in South Africa.

f Infections with Plasmodium falciparum accounted for 78% of all malaria cases and were acquired predominantly in sub-Saharan Africa (95%).

g Most cases of dengue fever (67%) occurred after exposure in Asia.

h Enteric fever was caused by Salmonella typhi (n = 14 [67%]), Salmonella paratyphi (n = 5 [24%]), and unspecified species (n = 2 [10%]). Most infections (83%) were acquired in Asia.

i Hyperactive airway disease represents the diagnoses of asthma, acute and chronic bronchitis, and bronchospasm.

j Acute otitis media, which usually occurs in the context of a respiratory infection, was analyzed within the group of respiratory disorders.

k Nondiarrheal gastrointestinal disorders were mostly infections with Schistosoma mansoni (n = 17 [15%]), Strongyloides stercoralis (n = 13 [11%]), or hepatitis A (n = 15 [11%]).

l Tissue parasites represent mostly schistosomiasis, human species not further identified (n = 13 [43%]), loiasis (n = 6 [20%]), and nonhepatic echinococcosis (n = 4 [13%]).

m Genitourinary disorders include infections with Schistosoma haematobium (n = 6 [29%]).

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and to Asia increased the odds of a systemic febrile illness diagnosis, whereas the reverse association was observed for travel to the Middle East/ North Africa. Although enteric fever (19%), dengue fever (17%), and malaria (9%) were the most common specific diagnoses for children returning from Asia, 64% of all systemic febrile illnesses after exposure to sub-Saharan Africa were attributable to malaria (all species) and 56% to infection with *Plasmodium falciparum*. One dengue fever case and no enteric fever case were observed after travel to sub-Saharan Africa. Exposure to Europe or North America was statistically associated with presentation with a respiratory disorder, compared with all other travel regions except Oceania. Pediatric travelers were more likely to present with animal bites after exposure in Asia (aOR: 4.62 [95% CI: 2.03–10.56]) or the Middle East/North Africa (aOR: 4.50 [95% CI: 1.80–11.28]), compared with exposure in Europe or North America.

DISCUSSION

Significant differences in travel characteristics, health care utilization, and the spectrum of travel-associated diseases were noted among the pediatric age groups and between children and adults. Greater proportions of young children (≤5 years) presenting with an illness after travel were VFR travelers and had returned after a prolonged trip (>30 days), compared with older children (>5 years) and adults. The travel patterns of pediatric travelers, particularly VFR pediatric travelers, have been only sparsely described in the travel medicine literature, although it has been suggested that immigrant families commonly travel with or send their children to family members in their country of origin for extended periods of time.14,15

The health care utilization of ill children returning after international travel differed significantly from that of adults. Ill children were less likely than adults to have received pretravel medical advice but were more likely to present for care within 7 days after return and to require hospitalization. The latter data corroborate a previous study that described an increased risk of hospitalization attributable to...
travel-related illnesses among pediatric international travelers. It is not clear whether children present with more-severe clinical illnesses or whether health care providers treat children more conservatively, which leads to more-frequent inpatient care. It is alarming that only approximately one-half of all children and one-third of VFR pediatric travelers in this study received pretravel care. Although this study is unable to determine the reasons for lack of pretravel care, it is likely that limited availability of travel-specific immunizations and medications in primary care settings and a lack of insurance or limited coverage through public and private health insurance plans play roles. Poor access to pretravel advice has been particularly asserted for VFR travelers, because of barriers at the health system level (eg, low insurance coverage rates), individual patient level (eg, lack of perception of risk), and health care provider level (eg, insufficient expertise in travel health). Other possible explanations for why so few children are reached by preventive travel medicine efforts may be that specialized travel clinics are not prepared to provide services to children and/or that pediatric health care providers are not sufficiently trained in travel medicine. This issue warrants further study. Innovative methods to improve access to pretravel services for VFR travelers have used approaches such as community-based programs (eg, in sports clubs, churches, or schools) and local-language programming through media to educate populations about risks. Additional efforts to increase education and to decrease barriers to care are crucial.

The most common diagnoses for ill children after travel were diarrheal disorders, skin conditions, systemic febrile illnesses, and respiratory problems. Although vaccine-preventable infections represented missed opportunities for prevention of disease, they were relatively uncommon, accounting for only 2% of overall diagnoses; most cases (71%) were attributable to infections with Salmonella typhi or hepatitis A virus. Previous surveys of travelers, including children, also reported that febrile illnesses and diarrhea were leading causes of morbidity, although they did not identify dermatologic conditions as a common cause of morbidity. This likely reflects the focus of previous work on hospitalized children, among whom dermatologic complaints may be underrepresented. Adults were more likely than children to be diagnosed as having diarrhea overall. Proportionate morbidity rates of both acute and chronic diarrhea differed between adults and children. Unspecified gastroenteritis, probably
caused by unidentified viral enteropathogens (eg, rotavirus), and bacterial diarrhea were statistically more common in children. In contrast, parasitic diarrhea and chronic diarrhea, as a group, disproportionately affected adults. The propensity of adults to present with parasitic diarrhea may be related to their overall longer travel duration, as suggested by previous data. Diarrheal disorders were diagnosed disproportionately among younger children, compared with older children. This may be related to young children’s immature immune systems and/or their active hand-to-mouth exploratory behavior. Previous studies assessing traveler’s diarrhea in children showed that younger children had higher attack rates and more-severe diarrhea than older children. In addition to young age, female gender, shorter travel duration, and exposure to the Middle East/North Africa were associated with increased risk for acquiring diarrhea. Given the lack of a biologically plausible explanation, the increased risk for diarrhea according to gender may represent an artifact of subject accrual. The association of short travel duration with increased risk of diarrhea also may be an artifact, because episodes of diarrhea among long-term travelers might have resolved before return from travel. Travel destination was found previously to be the most influential risk factor for travel-associated diarrhea. In agreement with our data, destinations in North Africa in particular were described previously to be associated with increased risk for travel-related diarrhea. Although ill children returning from other world regions considered to be high-risk areas for travel-associated diarrhea (ie, southern Asia and sub-Saharan Africa) showed evidence of significant risk of disease, no significant proportionate increase was noted, compared with children returning from Europe or North America.

Children presented with dermatologic conditions more frequently than did adults. The most-frequently observed diagnoses were animal bites and CLM. Although age was not statistically associated with risk, there was twofold increased risk for all dermatologic conditions associated with travel to Latin America, particularly the Caribbean region. This region was identified previously as a high-risk area for skin disease. In our study, 44% of pediatric cases of CLM occurred after exposure in the Caribbean region, presumably related to contact of unprotected skin with soil or sand, mostly on beaches. Exposure to Asia and the Middle East/North Africa was significantly associated with greater risk of being bitten by an animal. Children are more prone to and suffer greater rates of morbidity and death resulting from animal exposure. In fact, an assessment of indigenous populations concluded that rabies remains an important neglected disease in Asia and Africa, principally affecting children. Therefore, rabies preexposure prophylaxis for children traveling to rabies-endemic countries, particularly where the availability of rabies vaccine and human rabies immunoglobulins is restricted, should be considered.

Overall, children and adults were equally likely to present with systemic febrile illnesses. Among children, advancing age increased the proportionate morbidity rate. This finding is consistent with the experience that older children may spend more time outdoors, with increased risk of exposure to insect vectors and microbial pathogens. Exposure to sub-Saharan Africa, VFR travel, tourist travel, trip duration of >30 days, and male gender were associated with increased risks of systemic febrile illnesses. Malaria was the principal diagnosis, mostly acquired in sub-Saharan Africa and accounting for one-third of the ill children. Trip duration of >30 days and VFR travel were statistically associated with malaria acquisition. This corroborates findings from Europe and North America that children account for 15% to 20% of all imported malaria cases. The data also indicated that P falciparum acquired in sub-Saharan Africa was the most common infection and that VFR children accounted for a majority of cases. In contrast to studies in adults, no increased risk was found for male gender. Dengue fever and enteric fever were the most-frequently identified specific causes of systemic febrile illnesses among pediatric travelers returning from tropical regions other than sub-Saharan Africa.

This study has the following limitations. Pediatric travelers included in the GeoSentinel database are not representative of all children traveling internationally. In addition, the spectrum of diagnoses in this study is unlikely to represent a sample of illnesses in ill returning pediatric travelers who might be seen in a nonspecialized primary care practice, where mild or self-limited conditions would occur with greater frequency. Furthermore, children with illnesses with very short or prolonged incubation periods might have been underrepresented. For most specific etiologic diagnoses, only small numbers of cases were recorded; therefore, analytical statistics concentrated primarily on the most-frequently observed broad syndromic categories. Lastly, our data can be used to calculate relative morbidities among ill children after international travel but do not allow estimation of incidence rates among pediatric travelers, because the total number of pediatric travelers (denominator) is not known.
CONCLUSIONS

Ill children after international travel are less likely to have received pretravel medical services, present for care earlier, and are more likely to require hospitalization, compared with adults. Younger children presenting with travel-related morbidity are more likely to be VFR travelers and to have traveled for long periods. Diarrhea, skin conditions, febrile illnesses, and respiratory disorders are the most common problems in ill children after travel. Animal bites and malaria are the 2 most common specific diagnoses that allow for specific preventive interventions. Access to competent preventive pretravel health care for children should be improved. In addition to providing routine and travel vaccines and adequate malaria prophylaxis, such preventive services should concentrate on recommendations regarding skin care, sun and arthropod protection, protective shoe wear, and avoidance of contact with animals. 29 Caregivers of pediatric travelers should be prepared to provide supportive treatment for diarrhea and respiratory infections and should receive concise instructions on when and where to seek medical assistance while traveling. 30 Evidence-based guidelines for providing pretravel care to children, particularly higher-risk, VFR pediatric travelers, are needed.

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