Epidemiology of Travelers' Diarrhea: Details of a Global Survey

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Background: Recent epidemiologic data on travelers' diarrhea (TD) are essential for the evaluation of conventional and future prophylactic and therapeutic measures.

Methods: To determine the epidemiology, including risk factors, impact and quality-of-life evaluation of TD, a cross-sectional survey was conducted over 12 months at the airports of Mombasa (Kenya), Goa (India), Montego Bay (Jamaica) and Fortaleza (Brazil) by distributing questionnaires to visitors just prior to their flying home. The study period was March 1996 to July 1998.

Results: Overall, 73,630 short-term visitors completed a questionnaire. The total diarrhea attack rate varied between a high of 54.6% in Mombasa and a low of 13.6% in Fortaleza, but only between 31.5% and 5.4% of all travelers had classic TD. The 14-day incidence rates varied between 19.5% and 65.7%. Few travelers meticulously avoided potentially dangerous food items, although in India and Kenya most travelers avoided those considered most dangerous. Risk factors were stays exceeding 1 week, age between 15 and 30 years, and residence in the UK. The impact, measured as incapacity or quality-of-life scores, was very considerable.

Conclusions: TD continues to affect vacationers and business travelers as frequently as it did some 20 years ago. Compliance with recommendations to reduce exposure to pathogens by avoiding dangerous food items is poor among travelers from all countries. Implementation of food safety education programs may be difficult to achieve.

Every year, about 80 million people travel from industrialized countries to developing regions[1] (World Tourism Organization, unpublished data). Increases in the number of travelers to many destinations, only briefly interrupted by terrorist attacks and SARS, has resulted in a boom for the tourism industry and consequently has strained local infrastructures.

As demonstrated some 20 years ago, many travelers experience traveler's diarrhea (TD), especially during stays in tropical and subtropical areas.[2] Since then, no global assessment of TD has been conducted. Up-to-date epidemiologic data on TD are essential to evaluate conventional prophylactic and therapeutic recommendations, such as advice on the avoidance of potentially contaminated foods and beverages, and the need to pack a travel kit. In addition, prototype vaccines against various pathogens causing TD are on the horizon. We therefore conducted a survey on TD among tourists in Goa (India), Mombasa (Kenya), Montego Bay (Jamaica) and Fortaleza (Brazil).

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A detailed report of the Jamaica and Fortaleza segments[3,4] and selected epidemiologic data from all four study sites have recently been published.[5] Here we present a full report on the overall epidemiology, risk factors and impact at all four study sites. The survey not only investigated the epidemiology of TD but also examined the etiology of TD, as described elsewhere.[6]

Methods

The methods have been previously described.[3] Here we describe only the epidemiologic data. Essentially, a cross-sectional survey was conducted in travelers leaving from the international airports in Goa (India), Mombasa (Kenya), Montego Bay (Jamaica) and Fortaleza (Brazil).

The study protocols were reviewed by the local Institutional Review Boards and that of the University of Zurich Institute of Social and Preventive Medicine. Between March 1996 and July 1998, pretrained interviewers of the respective countries' tourist boards invited departing travelers of both sexes, aged ≥ 16 years, to fill in one of two types of self-administered questionnaire while waiting in the departure hall after clearing customs. Developing country residents (except Brazilians in Fortaleza, since they come from areas different in climate and infrastructure) and long-term visitors, staying > 100 days, did not receive a questionnaire or they were later excluded. The questionnaires were provided in several languages reflecting the composition of the tourists. The questionnaires were limited to four pages so that they could be completed quickly. Both questionnaires QA and QB had closed questions relating to personal data, incidence and characteristics of diarrhea and place of stay (hotel) on two pages, with different sets of questions on the remaining two pages. QA inquired about pretravel health advice and economic features. QB investigated food and beverage consumption and quality of life. Questionnaires were distributed for 1 week every month for a 12-month period. QA was distributed 6 days a week, and QB on the randomly selected remaining day. The study staff actively collected the questionnaires before the travelers went to board the plane.

Risk Factors

Twelve risky food items or risky behaviors (drinking tap water, consuming ice cubes, dairy products, ice-cream, rare meat, local dishes while not adhering to the rule "cook it, peel it, boil it or forget it", hamburgers, raw oysters, lobster or shrimps, salad and creamy dressings, and buying food from street vendors) were to be evaluated. If the above items were consumed occasionally, a score of 1 per item was given, or if they were consumed daily, a score of 2 was given, resulting in a maximum score of 24.

Quality of Life

To assess quality of life, a 10-item questionnaire, aimed at assessing quality of life in relation to contracting TD, was designed and included in the type B questionnaire. Each item scored along a seven-point Likert scale. The maximum score for the best quality of life a traveler could experience would be 70 (10×7), and the poorest one would be 10 (10×1). Those travelers not completing all 10 quality-of-life questions were excluded from this part of the analysis.

Definitions

As in a previous study,[5] classical TD was defined as the passage of ≥ 3 unformed stools per 24 h, with at least one accompanying symptom (nausea, vomiting, abdominal cramps or pain, fever, blood in stools). Moderate TD was the passage of 1–2 unformed stools with at least one additional symptom or more unformed stools without additional symptoms. Mild TD was the passage of 1–2 unformed stools without additional symptoms. The severity of accompanying symptoms was graded 1–4 by the patient. Both the attack rate of TD for the unspecified entire duration of stay at the destination and the 2-week incidence rate of TD, selecting only the population having stayed abroad for 14 or 15 days, are described. The latter results differ slightly from a mathematical extrapolation previously published.[5] Summer was defined as May to October, and winter as November to April, in the northern hemisphere, and vice versa for the southern hemisphere. Incapacitation was defined as inability to pursue planned activities. TD with impact was defined as TD resulting in incapacitation or contact with a local health professional (doctor, pharmacy staff, nurse) or self-medication to relieve the symptoms.

Statistical Analysis

Data management and tabulations were performed with EpiInfo (version 6.04b, CDC, Atlanta, GA). SAS (version 6, Cary, NC) was used to help with the statistical analysis. The attack rates of diarrhea are presented as simple proportions with 95% confidence limits. Kruskal–Wallis and chi-squared tests were applied to compare continuous and discrete predictor variables. The stratified Mantel–Haenszel method was used to test for confounding variables.

Results

Population

In total, 73,630 travelers completed questionnaires which could be evaluated. For most flights, the interviewers reported response rates clearly exceeding 80%; lower rates occurred for night flights or when large groups of passengers not understanding any of the languages in the question-

Table 1 Demographic Details of Participants, Purpose and Duration of Stay

	India, Goa	*Kenya, Mombasa*	*Jamaica, Montego Bay*	*Brazil, Forzaleza*
Study period	December 1996 to November 1997	August 1997 to July 1998	March 1996 to May 1997	March 1997 to February 1998
Number of valid questionnaires	15,631	15,180	30,369	12,449
Demographics				
Male/female ratio	0.86	0.90	0.90	1.74
Females' mean age (years) (SD)	40.6 (12.9)	38.1 (13.5)	33.5 (10.6)	34.0 (11.5)
Males' mean age (years) (SD)	42.9 (12.9)	40.7 (13.2)	35.3 (10.9)	37.4 (10.9)
Purpose of stay				
Holiday (%)	93.8	90.8	69.9	60.3
Honeymoon (%)	1.8	6.2	23.6	3.5
Business (%)	1.2	0.6	2.0	23.0
Other/no answer (%)	3.2	2.4	4.5	13.2
Duration of stay				
Mean (days) (median)	13.0 (14.0)	13.2 (14.0)	7.7 (7.0)	9.8 (7.0)
Countries of residence				
First rank (%)	UK 65.8	UK 43.2	US 71.4	Brazil 38.4
Second rank (%)	Finland 11.4	Germany 23.9	UK 9.3	US 16.6
Third rank (%)	Sweden 6.0	France 14.3	Canada 5.3	O/EU 14.1
Fourth rank (%)	Germany 4.7	Italy 8.7	Japan 4.6	Italy 13.9
Fifth rank (%)	Switzerland 2.3	Switzerland 4.6	Germany 3.0	O/SA 6.9

O/EU, other European; O/SA, other South American.

naires were waiting to board. Except for Fortaleza, where markedly more men participated, the numbers of men and women participating were similar (Table 1). Participants were slightly older in Goa and Mombasa. There were no significant differences between the demographic characteristics of the populations who responded to questionnaires A and B. The majority of travelers were on holiday, although in Fortaleza 23.0% were there for business reasons, and in Jamaica, 23.6% were on honeymoon. Travelers to Kenya and India stayed on average nearly twice as long as travelers to the other two destinations (Table 1).

TD Rates, Symptoms and Chronology

The total TD attack rates were high in India and Kenya (Table 2), more than double those of the other two study sites. Most patients—except in Fortaleza—suffered classical TD, but less severe forms of diarrhea also affected numerous travelers. Two-week TD incidence rates were higher than the attack rates; they exceeded 60% in Goa and Mombasa. Between 54% and 70% of the patients at all four study sites had one or several accompanying symptoms; among those who had such symptoms, more than half had only one of them (Table 3). The most frequently reported accompanying symptoms were pain and cramps, followed by nausea. Between 1% (Fortaleza) and 7% (Goa) of all travelers had subjective fever and/or blood admixed with their stools. At all sites, more than 60% of the patients had 3–5 stools during the worst 24 h of their diarrhea; the proportion with a maximum number exceeding 10 watery bowel movements was highest in Goa, at 8.4%. The median time of onset for any diarrhea was day 3–4 at all destinations. For the different severity stages of diarrhea, the time of onset did not differ much from the overall time of onset, but in Fortaleza and Goa there was an earlier onset of mild diarrhea. Risk was greatest in the first week of the stay, and thereafter it gradually decreased. The mean duration of TD varied between 63 and 106 h at the various destinations. The duration was longer for more severe TD.

Risk Factors

Gender-related differences in attack rates could be detected neither in total nor in classic incidence rates. At all four study sites, younger adults were at the highest risk for any type of diarrhea (Table 2), for classic TD, and for moderate and mild diarrhea (data not shown). Tourists and honeymooners suffered markedly more diarrhea than business travelers at all destinations. A stay in a tropical country in the 6 months prior to the current trip protected significantly against TD, except in Fortaleza. In Goa, there was a significant seasonal effect, with markedly lower rates during the local monsoon months June to September and a sharp increase at its end in October. Similarly, in Montego Bay the attack rates were markedly lower during winter, whereas for Mombasa and Fortaleza, a seasonal pattern was less obvious. On comparison of countries or regions of residence, it was found that British travelers experienced significantly more diarrhea than other travelers at the three sites where

Table 2 Epidemiology of TD at the Four Study Sites

	Goa	*Mombasa*	*Montego Bay*	*Fortaleza*
Total TD attack rate (%) (CI)[a]	53.9 (0.8)	54.6 (0.8)	23.6 (0.5)	13.6 (0.9)
Classic TD attack rate (%) (CI)	31.5 (0.7)	30.5 (0.7)	11.7 (0.4)	5.4 (0.6)
Moderate TD attack rate (%) (CI)	16.6 (0.6)	17.4 (0.6)	8.3 (0.3)	5.5 (0.6)
Mild TD attack rate (%) (CI)	5.8 (0.4)	6.7 (0.4)	3.6 (0.2)	2.8 (0.4)
Mean day of onset any TD (median)	5.3 (4.0)	5.2 (4.0)	3.9 (3.0)	5.1 (3.0)
Total TD incidence rate[a]				
Male (%) (CI)	61.6 (1.5)	62.5 (1.6)	37.3 (2.4)	20.6 (5.3)
Female (%) (CI)	60.7 (1.4)	65.8 (1.5)	39.3 (2.3)	17.5 (6.8)
Classical TD incidence rate				
Male (%)	36.0	35.5	18.8	8.8
Female (%)	37.4	41.7	22.3	5.8
Total TD incidence rate by age				
$<$36 years (%) (CI)	68.6 (1.6)	71.4 (1.5)	42.6 (2.1)	19.6 (5.3)
36–55 years (%) (CI)	59.5 (1.5)	59.9 (1.7)	33.2 (2.9)	20.3 (7.1)
$>$55 years (%) (CI)	47.2 (2.8)	48.6 (3.5)	13.5 (5.2)	8.3 (15.6)
Total TD incidence rate by purpose of stay				
Holiday (%) (CI)	61.2 (1.1)	63.4 (1.1)	35.7 (1.8)	21.7 (5.0)
Business (%) (CI)	43.8 (24.3)	33.3 (23.9)	33.3 (26.7)	23.1 (13.2)
Honeymoon (%) (CI)	70.9 (6.7)	76.6 (3.5)	52.0 (4.1)	NA
TD incidence rate and recent travel				
With stay in tropical country during preceding 6 months (%) (CI)	40.4 (8.1)	54.8 (9.2)	27.3 (7.7)	13.9 (7.6)
No stay in tropical country during preceding 6 months (%) (CI)	61.3 (1.1)	64.8 (1.2)	40.1 (1.9)	22.1 (5.4)

CI, 95% confidence interval; NA, not assessed.

[a]Attack rate is for unspecified duration of stay, and incidence rate for a stay of 2 weeks.

Table 3 Accompanying Symptoms in all TD Patients

	Goa			*Mombasa*			*Montego Bay*			*Fortaleza*		
Symptom	*n*	*%*	*AVS*	*n*	*%*	*AVS*	*n*	*%*	*AVS*	*n*	*%*	*AVS*
Total with diarrhea	8,423	100.0		8,286	100.0		7,182	100.0		1,665	100.0	
Abdominal cramps	5,098	60.5	2.0	4,366	52.7	2.2	3,387	47.2	2.3	638	38.3	1.8
Nausea	2,536	30.1	1.9	2,196	26.5	2.0	1,855	25.8	2.0	253	15.2	1.8
Vomiting	1,567	18.6	2.1	1,081	13.0	2.4	613	8.5	2.3	148	8.9	1.9
History of "fever"	1,003	11.9	2.0	708	8.5	2.0	507	7.1	2.1	134	8.0	1.9
History of having blood in stools	241	2.9	1.5	159	1.9	1.5	200	2.8	1.6	44	2.6	1.7
With 1 symptom	3,288	39.0		3,134	37.8		2,667	37.1		554	33.3	
With 2 symptoms	1,463	17.4		1,330	16.1		1,212	16.9		206	12.4	
With 3 symptoms	745	8.8		558	6.7		431	6.0		86	5.2	
With 4 symptoms	276	3.3		198	2.4		133	1.9		30	1.8	
With 5 symptoms	66	0.8		49	0.6		75	1.0		8	0.5	
Total with symptoms	5,838	69.3		5,269	63.6		4,518	62.9		884	53.1	

AVS, average severity grade, rated 1/mild to 4/very severe.

this could be analyzed. This pattern remained significant even when the population was stratified by age, class of hotel, and whether all meals were taken there (data not shown) (Table 4). There were insufficient data to include Fortaleza in Table 4.

Prophylactic Measures and Their Effect

The large majority of travelers to Goa and Mombasa received health advice prior to traveling to their destination; among those traveling to Montego Bay and Fortaleza, this proportion was far smaller (Table 5).

Table 4 TD Incidence Rates per Country of Origin

	Goa			*Mombasa*			*Montego Bay*		
Origin	*n*	*% All TD*	*% CTD*	*n*	*% All TD*	*% CTD*	*n*	*% All TD*	*% CTD*
Canada	NA			NA			207	40.1	20.3
France	NA			355	48.7	19.4	NA		
Germany	195	34.4	17.9	1,789	52.8	26.1	552	20.7	7.2
Italy	NA			354	41.0	19.2	89	21.3	5.6
Scandinavia	652	49.8	26.4	NA			NA		NA
Switzerland	173	31.8	16.8	189	41.3	21.2	NA		
UK	6,667	65.4	40.3	4,523	72.9	47.9	1,863	46.8	27.3
US	NA			NA			351	28.8	17.1

CTD, classic travelers' diarrhea; NA, not available due to insufficient number of people having stayed for 2 weeks.

In Fortaleza, all nationalities had similarly low total rates of TD: south/southeastern Brazil 11.9% ($n = 4,629$), Argentina, Chile, Uruguay 13.0% ($n = 863$), US 12.1% ($n = 2,064$), Italy 15.3% ($n = 1,733$), rest of Europe 17.6% ($n = 1,750$); most 95% confidence intervals were overlapping.

Table 5 Impact and Medical Support for TD at the Four Study Sites

	Goa	*Mombasa*	*Montego Bay*	*Fortaleza*
Incapacitation in all patients (%) (CI)	45.7 (1.1)	29.4 (1.0)	31.0 (1.1)	11.9 (2.9)
Incapacitation in all travelers (%)	29.9	20.9	8.3	4.2
Duration of incapacitation, any TD (h) (SD)	21.2 (40.0)	15.6 (40.0)	11.6 (30.3)	10.5 (32.4)
For mild TD (h) (SD)	3.7 (23.4)	1.9 (16.2)	2.6 (16.3)	1.2 (7.3)
For moderate TD (h) (SD)	10.9 (30.8)	6.0 (24.9)	7.5 (30.0)	5.9 (29.3)
For classic TD (h) (SD)	29.5 (44.0)	24.1 (47.8)	17.1 (32.5)	19.0 (39.4)
Mean duration any TD (h) (SD)	84.6 (94.2)	106.2 (102.5)	72.7 (66.6)	62.7 (91.3)
QoL, no TD	63.9	63.0	64.3	66.8
QoL, any TD	56.0	56.5	58.1	58.9
QoL, mild TD	63.2	61.8	62.4	64.4
QoL, moderate TD	58.4	58.6	60.3	62.9
QoL classic TD	53.4	53.8	54.9	54.5
Health advice prior to travel (%)	74.9	83.8	16.7	20.2
Medication for any TD (%)	62.7	59.4	33.3	38.7
Medication for classic TD (%)	70.2	67.1	42.5	53.0
Medical help[a] for any TD (%)	14.6	7.5	6.6	17.1
Medical help for classic TD (%)	20.5	11.3	10.5	29.3

[a]Doctor, nurse, pharmacy, hospital, other health professionals.

QoL, quality of life.

Diarrhea was more frequent among those travelers who sought health advice: in Goa and Mombasa, 59% and 57%, respectively, of those who mentioned receiving health advice suffered from TD, compared to 36% and 44%, respectively, of those not receiving health advice. In Montego Bay, 34% of those seeking advice suffered diarrhea vs. 22% of those not seeking advice. In Fortaleza, the numbers were 17% vs. 14%. For all study sites, the majority of travelers who sought health advice obtained it from a medical doctor, but some (Montego Bay 28%, approximately 10% for Goa and Mombasa) also sought advice from their travel agent.

Only in Mombasa was the difference in scores of consumed dangerous food between those who did and did not have diarrhea statistically significant (Tables 6 and 7). In Montego Bay and Fortaleza, the majority of travelers did not avoid many potential dangerous food and beverage items, although most of them consumed the risky items only occasionally. The mean score for consumption of risky food items and beverages was lower in Mombasa and Goa than at the other two destinations. Again, most of those who consumed dangerous items did so only occasionally. Differences between items that were avoided, such as drinking tap water and dairy products, are shown in Table 6. Ice cubes were often avoided everywhere except in Montego Bay, where almost everybody consumed them. Local dishes were avoided far less in Goa than in Mombasa or the other sites. Compliance with food and beverage avoidance is shown in Table 7. The place of food consumption showed different results at the various study sites; whereas having all meals at the hotel showed a significant benefit in Goa, this was associated with higher TD rates

Table 6 Consumption of "Risky" Food and Beverage Items

Consumption of	Goa			Mombasa			Montego Bay			Fortaleza		
	Total Number	Regular %	Occasional %	Total Number	Regular %	Occasional %	Total Number	Regular %	Occasional %	Total Number	Regular %	Occasional %
Tap water	1,583	1.3	3.5	2,524	0.6	3.8	3,435	51.8	28.2	913	1.6	14.3
Ice cubes	1,590	5.0	20.1	2,563	12.5	36.8	3,478	83.4	14.1	941	24.9	61.6
Dairy products	1,590	26.5	47.5	2,546	23.5	41.6	2,949	62.0	38.0	924	23.1	61.4
Ice cream	1,589	7.6	44.3	2,546	5.8	41.1	3,371	24.0	34.4	931	16.5	63.1
Rare meat	1,554	3.1	9.0	2,536	2.5	21.0	3,327	7.8	18.7	911	8.3	48.2
Local dish[a]	1,607	24.1	48.6	2,448	2.3	13.4	3,446	24.6	52.1	918	5.6	53.4
Hamburgers	1,552	2.2	13.3	2,511	2.1	21.6	3,397	18.6	48.4	912	6.0	57.7
Raw oyster	1,550	2.7	9.1	2,506	2.1	16.1	3,302	2.3	3.0	908	5.7	46.4
Lobster/shrimps	1,576	10.9	46.7	2,533	4.9	39.7	3,398	12.4	47.0	931	10.5	67.3
Salad	1,607	16.9	48.3	2,581	45.5	37.6	3,456	57.1	36.1	928	15.7	58.9
Creamy dressing	1,568	3.3	26.1	2,531	14.7	40.7	3,383	29.1	39.3	918	12.2	50.9
Street vendors' products	1,577	5.1	23.9	2,541	16.9	8.5	3,407	6.7	17.7	912	2.6	24.8

[a]A local dish is a dish typical for the study site which did not adhere to the rule "cook it, boil it, peel it, or forget it", such as jerk chicken (Jamaica).

in the Kenya coast area. When drinks were free, higher diarrhea rates were observed (Table 8).

Impact and Consequences

About half of the patients in Goa, and about one-third in Mombasa and Montego Bay, were incapacitated; the numbers were clearly lower in Fortaleza. The duration of illness and of impairment increased with increasing severity of diarrhea (Table 5). When we related the mean duration of any diarrhea to the mean duration of stay, we found that, on average, patients experiencing TD had symptoms for 27.1% of their time in Goa, with respective rates of 32.5% in Kenya, 39.3% in Jamaica and 27.7% in Brazil (Table 5). The quality of life was considerably affected and was directly related to the severity of diarrhea, with classic diarrhea having the greatest impact (Table 5).

When asked if they would return to the same country, between 70% and 80% of the travelers indicated that they would. Very few travelers answered that they would not come back for health reasons (between 0.1% and 1.4%). Of those who indicated that they would not come back, the majority had suffered diarrhea. Similar proportions were obtained when they were asked if they would travel to a similar country.

In Goa and Mombasa, markedly more patients took medication or sought medical help than at the other two study sites (Table 4). Medical help came in most cases from a medical doctor or a pharmacy, although in Montego Bay the resident hotel nurse was consulted most frequently. Among all travelers who went there, in Goa 34.6% had TD with some impact; this rate was 32.7% in the region of Mombasa and 8.1% in Montego Bay. Eleven patients were hospitalized for TD in Kenya, three in India, and none in the other two countries.

Discussion

For the first time since 1983, various aspects of the epidemiology of TD have been documented at four important tourist destinations on three continents.[2] The method used was not identical—questionnaires were completed in the departure lounges as compared to during the return flight. Despite a potential bias, it appears that the rate of TD has not decreased significantly over the past 20 years at the various destinations where it was studied.[2] This might indicate that, despite booming tourism, improvements in food and water safety are lagging behind or not sufficient to meet the increasing needs.

Marked differences in attack rates were noted between the four study sites. The highest rates were observed in Goa and the Kenya coastal area, whereas in Jamaica the attack rates indicate a country at the limit between intermediate and high risk.[3] Since the study end at the Jamaica

Table 7 Mean Food Score in Travelers with and without TD

	Goa	*Mombasa*	*Montego Bay*	*Fortaleza*
Mean food score				
Travelers without TD (SD)	5.2 (3.2)	5.2 (2.9)	10.9 (3.6)	8.6 (3.2)
Travelers with TD (SD)	5.4 (2.6)	5.8 (2.9)	11.2 (3.1)	9.0 (3.1)

The food score was calculated for 12 items with potential for contamination (occasional = 1, regular = 2, with a maximum of 24 points).

Table 8 Correlation of Meal Arrangement and Location of Meal Intake with TD Incidence Rates

	Travelers' Diarrhea Attack Rate (%)		
	Goa	*Mombasa*	*Montego Bay*
Reported behavior			
All meals at hotel	43.8	64.2	28.6
Occasional meals (1–20%) outside	67.2	59.0	36.7
Many meals (> 20%) outside	67.9	53.6	28.2
Meal plan			
No meals included	51.1	45.5	35.7
Breakfast only included	68.0	58.1	15.2
Breakfast and dinner included	68.2	61.7	20.0
All meals included	43.8	47.4	NA
All meals and drinks included	65.5	67.4	35.3
	Significant	Significant	Not significant

NA, not assessed.
Insufficient numbers for Fortaleza.

site, a surveillance system has been set up to continue monitoring the TD incidence; this will help in the control of TD and the improvement of environmental health and food safety practices within hotels.[6] Fortaleza (Brazil), on the other hand, appears to be a low-risk destination for TD. At all four study sites, the attack rates are matched by the severity of diarrhea.

We did not detect a gender difference for total diarrhea attack rates at any of the four study sites, but, as in previous studies, younger people (< 36 years of age) were at increased risk of TD. A definite explanation for this is not available, but it has been suggested that this may be related to the larger appetites of younger people.[3] Other factors may play a role in this, but more adventurous places of food consumption are certainly not the only answer, since significant age-related differences remain even when travelers have all meals at the same place. At all four sites, the diarrhea attack rates increased with increasing duration of stay until days 12 to 14, and decreased or leveled off after that. Seasonal patterns in the diarrhea attack rates were very clear for Goa and Montego Bay but not obvious for the other two sites. No definite explanation is available, since no clear seasonal pattern was established in the prevalence of the responsible pathogens.[3,6] Thus, there may be some other determining factors.

Diarrhea attack rates are very similar between Mombasa and Goa, suggesting that they are typical of a high-incidence area for TD and not so much typical of a specific site. There were a few interesting differences: there appears to be a tendency for a lower incapacitation rate in Mombasa with a lower duration of impairment, except for classic TD. Whether this feature is of clinical significance remains to be determined. In contrast, the hospitalization rate was highest in Kenya—this may be attributed to the observation that some doctors attending to tourists in hotels have built private clinics nearby where they treat TD with antibiotic infusions, usually for one night. Otherwise, the degree of medical help relates to TD severity. Whereas it clearly seemed safest to have all meals at the hotel at the Indian site, to some extent the contrary seemed to be the case on the Kenya coast. The markedly higher rates of diarrhea observed when not just all meals, but also drinks, were included in the package may indicate that alcohol is a contributory factor to TD.

A stay in a tropical country in the 6 months prior to this trip appears to be protective against TD, except for those traveling to Fortaleza. Such protection has been linked to the development of immunity.[7] Business travelers appear to be less affected by TD, possibly because such travelers do not stay very long at their destination, or they stay in better hotels.

Quality of life was clearly affected by any severity of TD at all four study sites. This indicates that the effect on the quality of life is not related to the destination being a high- or low-risk area for TD.

In general, travelers of all nationalities do not fully comply with precautions relating to the consumption or avoidance of so-called high-risk food items. Some food items, such as tap water, rare meat, and raw oysters, were avoided by the majority of visitors to Goa or Mombasa, but other items on the list, such as dairy products and salads, were not avoided. Possibly, travelers correctly consider Mombasa and Goa as known high-risk areas, but not so much the other two destinations. Those with and those without diarrhea are similar with regard to the dangerous food score. Taking health advice does not seem to be protective; on the contrary, TD attack rates are higher in those who have taken health advice. Possibly there is a bias, because people who take advice prior to travel are more aware of TD, possibly on the basis of previous illness, which again may indicate experience of personal susceptibility to TD. In general, health advice is most frequently obtained from a medical doctor, but it is also obtained from travel clinics or travel agents. No differences in outcome by information source could be detected.

In conclusion, we have shown that, over the past decades, TD has remained a frequent cause of morbidity among Western visitors to (sub)tropical holiday destinations. Even milder forms of TD have an impact on travelers, and can disturb holiday or business trips. Travelers originating from any industrialized country and visiting destinations at high risk for TD do not seem to comply with dietary recommendations to avoid potentially dangerous food, although there are indications they are aware of the risk of contracting TD at those destinations. Thus, other means of prevention or instructions for self-therapy must be considered.[10]

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Declaration of Interests

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