International Journal of Epidemiology

Vol. 14, No. 1
Printed in Great Britain

'Boil it, Cook it, Peel it or Forget it': Does this Rule Prevent Travellers' Diarrhoea?

MARKUS KOZICKI, ROBERT STEFFEN AND MEINRAD SCHÄR

Kozicki M (Institute of Social and Preventive Medicine of the University, Gloriastrasse 30, CH-8006 Zurich, Switzerland), Steffen R and Schär M. 'Boil it, cook it, peel it or forget it: Does this rule prevent travellers' diarrhoea? *International Journal of Epidemiology* 1985, **14**: 169–172.

A total of 688 out of 2240 air charter passengers in flight to Kenya, West Africa or Sri Lanka/Maldives volunteered to participate in a follow-up study investigating the influence of various food and beverage items on the incidence of travellers' diarrhoea. Within the first three days of their stay abroad, 98% accepted food or beverages whose avoidance is traditionally recommended. The incidence of diarrhoea, which was 19.5%, was proportionate to the number of dietary mistakes committed. The most dangerous items were those whose avoidance was traditionally recommended.

As long ago as 1692, a medical officer of the Dutch-East Indian Company was warning colonists not to eat salads.[1] Ever since then for protection against travellers' diarrhoea, doctors were promulgating long lists of the foods and beverages which visitors to developing areas should avoid.[2] However, most studies investigating the benefits of such dietary self-restrictions have demonstrated no or only limited benefit: In Mexico, drinking bottled liquids and avoiding salads, raw vegetables or unpeeled fruits—or any combination of these precautions—failed to prevent illness at an international congress,[3] or in American[4] and Panamanian tourists.[5] At another congress in Mexico, the attack rate was similarly unaffected by drinking tap water, or consuming uncooked food. A significant association was only found between consumption of salads containing raw vegetables and infection with enterotoxigenic E. coli.[6] In our own worldwide survey on 16568 tourists, travellers' diarrhoea seemed to be more frequent, the more one tried to elude it:[7] the only significantly pernicious agent was tap water. Only the recently compiled evaluation of the frequency of diarrhoea in American travellers who visited Europe in 1969/70 detected raw vegetables and un- or undercooked meat, fish and shellfish as high-risk foods.[8] The vast majority of these results stands in contrast to the evidence that mainly uncooked food is contaminated.[9,10] Therefore, suspicion arose that retrospective questioning might have biased the results, and it was suggested that this ought to be clarified by a follow-up study.[7]

Institute of Social and Preventive Medicine of the University, Gloriastrasse 30, CH-8006 Zürich, Switzerland.

METHODS

All 2240 charter tourists, aged at least 14 years and able to speak German, on board 27 Balair flights to Sri Lanka, East or West Africa during the summer of 1982 obtained a questionnaire in the German language, consisting of 10 pages. They were asked immediately to indicate age, sex, destination, reason for and type of journey, previous journeys to the tropics or subtropics, health status, current medication, previous history of diarrhoea. Additionally they were invited on the first three days of their visit to specify after each meal what (list of 45 items) and where they had eaten. The use of tap water for cleaning the teeth was included. For the first five days of the stay abroad, the occurrence of diarrhoea, and its symptoms were investigated. Upon their return the travellers were asked to send the completed questionnaires immediately to our institute.

Travellers' diarrhoea was defined as previously stated[7] as the occurrence of three or more watery or unformed stools per day or any number of such stools when accompanied by fever, abdominal cramps, or vomiting. *Loose motions* meant 1–2 watery or unformed bowel movements without any of the above-mentioned additional symptoms. The term *diarrhoea* was used for the sum of travellers' diarrhoea plus loose motions. The incidence of diarrhoea was assessed for each item on the food and beverage list. The food and beverages consumed after diarrhoea had occurred were not taken into consideration. Differences of diarrhoeal rates in consumers versus non-consumers of any one item were analysed by Fisher's exact test for $n < 20$, by X^2-Test for any number above. A total of 17 'dietary mistakes' were defined, including all uncooked food, fruits which could not be peeled or unbottled cold beverages.

People under antibiotic medication or taking anti-motility drugs (n = 8), those with a history of frequent diarrhoea at home (n = 4) or suffering from diarrhoea during the flight (n = 2) were excluded. Twelve additional questionnaires were not evaluated because of incomplete or contradicting data.

RESULTS

In all 688 of the charter tourists (30.7%) returned completed questionnaires; 26 (3.8% of the questionnaires) had to be exluded for the abovementioned reasons. The age range was 14–75 years, and the average age 36.5 years; 48% of the population were male; 91% of the travellers were vacationers; 6% were visiting relatives. Within the 662 evaluated tourists, 129 (19.5%) suffered from travellers' diarrhoea within the first five days of their stay abroad.

Only 13 travellers (2%) adhered strictly to the rules and committed no dietary mistakes at all. Five dietary mistakes was the single most frequent number and nobody had more than 13 lapses (Figure 1). Of the investigated population, 71% consumed salads/uncooked vegetables, 70% ate fruit which could not be peeled, and 53% accepted ice cubes. Usually the travellers committed the same lapses every day. The incidence of diarrhoea was significantly dependent on the number of dietary mistakes ($p < 0.01$, Figure 1). The additional increase in incidence became small when more than five high risk items were consumed. The incidence according to various food and beverage items are listed in Table 1. Raw oysters, beefsteak tartar, sandwiches with mixed fillings, unpeeled fruits, cold milk, bottled water without carbonic acid, puddings, ice cubes, etc., showed the highest risk, but only a very few succumbed to the most dangerous of these items.

The vast majority of the interviewed travellers always ate at the hotel. No significant differences were detected when eating place, age, sex, travel style were compared with food and beverage items. The diarrhoeal incidence varied from 12% in Sri Lanka to 22% in Togo and Kenya. This difference may partly be due to differences in local cooking habits: In Sri Lanka 34%, in Togo 48%, in Kenya 71% consumed more than four risky items. Those visiting the tropics for the first time (n = 312) were more often affected than others (23% versus 16%, $p < 0.05$), but they did not differ in the number of dietary mistakes. No differences in the risk pattern were detected, when the cases occurring on the fourth and fifth day were eliminated.

Twenty-two per cent of the 409 vacationers who

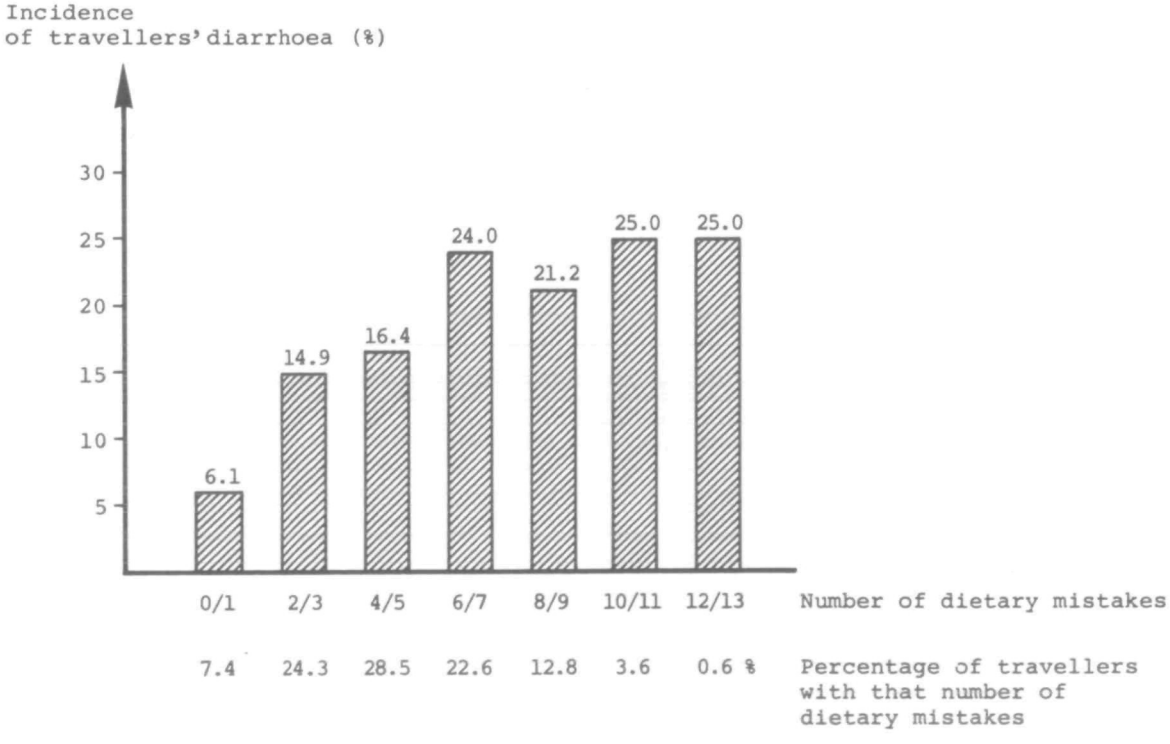

FIGURE 1 *Correlation of dietary attitude and incidence of travellers' diarrhoea.*

brushed their teeth using tap water got diarrhoea as compared to 16% in the more prudent group ($p = 0.06$).

DISCUSSION

A response rate of 30% is not representative, but we have decided to publish the information for four reasons: First, these results contradict those in the retrospective studies,[3-7] adding to the suspicion that the earlier results were biased. Second, the correlations noted here are biologically plausible. Third, it appears almost impossible to motivate a larger proportion of vacationers, who are the major group of travellers,[7] to

TABLE 1 *Incidence of travellers' diarrhoea after the consumption of various food and beverage items ($n = 662$).*

	Item consumed			Item not consumed			
		Diarrhoea			Diarrhoea		
	n =	n =	%	n =	n =	%	Significance
Beverages							
— Mineral water	525	110	21.0	137	19	13.9	0.05<p<0.1
— Bottled water (without carbonic acid)	135	35	25.9	527	94	17.8	p<0.05
* Tap water	16	5	31.3	646	124	19.2	—
— Water from thermos flask	145	34	23.5	517	95	18.4	—
* Ice cubes in drink	348	78	22.4	314	51	16.2	p<0.05
— Fruit juice (bottled)	107	18	16.8	555	111	20.0	—
— Fruit juice (not bottled)	428	88	20.6	234	41	17.5	—
— Milk (hot)	134	21	15.7	528	108	20.5	—
— Milk (cold)	130	34	26.2	532	95	17.9	p<0.05
— Beer	350	65	18.6	312	64	20.5	—
— Wine	229	40	17.5	433	89	20.6	—
— Various	308	65	21.1	354	64	18.1	—
Food							
— Butter (packaged)	146	28	19.2	516	101	19.6	—
— Butter (unpackaged)	499	101	20.2	163	28	17.2	—
— Cheese	245	45	18.4	417	84	20.1	—
— Yoghurt	36	5	13.9	626	123	19.6	—
— Meat (warm)	617	119	19.3	45	10	22.2	—
* Meat (cold)	227	53	23.3	435	76	17.5	0.05<p<0.1
* Steak tartar	8	4	50.0	654	125	19.1	p<0.05
— Fish (warm)	430	80	18.6	232	49	21.2	—
* Fish (cold, e.g. sardines)	155	32	20.6	507	97	19.1	—
— Seafood (warm)	117	19	16.2	545	110	20.2	—
* Seafood (cold)	75	18	24.0	587	111	18.9	—
* Oysters (raw)	3	2	66.7	659	127	19.3	p<0.05
— Vegetable (warm)	569	102	17.9	93	27	29.0	—
* Vegetable (raw, salads)	470	100	21.3	192	29	15.1	0.05<p<0.1
— Tomato (peeled)	70	10	14.3	592	119	20.1	
* Tomato (unpeeled)	393	85	21.6	269	44	16.4	
* Sandwiches with cold meat	112	29	25.9	550	100	18.2	0.05<p<0.1
— Sandwiches with eggs	118	27	22.9	544	102	18.8	—
— Sandwiches with cheese	98	22	22.4	564	107	19.0	—
* Sandwiches with various items (e.g. salads)	26	9	34.6	636	120	18.9	p<0.05
— Warm sauces	459	88	19.2	203	41	20.2	—
* Cold sauces (e.g. Mayonnaise)	185	40	21.6	477	89	18.7	—
— Fruits (self peeled)	344	59	17.2	318	70	22.0	—
* Fruits (served peeled)	465	84	18.1	197	45	22.8	—
* Fruits (unpeeled)	51	14	27.5	611	115	18.8	—
* Creme desserts	290	56	19.3	372	299	19.6	—
* Puddings	244	60	24.6	418	69	16.5	p<0.05
* Ice cream	120	29	24.2	542	100	18.5	—

* Items considered as dietary mistake.

volunteer for such a time consuming study. Age and sex distribution—controlled with a very short questionnaire on other flights to the same destinations (answer rate 81%)—showed no significant difference. And last, it appeared urgent to caution the public, in view of press reports in several European and North American countries which, based on retrospective studies, have stated that exposition prophylaxis is useless in prevention of diarrhoea. To avoid classifying the many food and beverage items into larger and less instructive categories, we decided not to use multivariate analysis. This, of course, reflects a further limitation of this study.

Although the data are limited, two points can be made: This follow-up study supports the still unproven hypothesis that dietary abstention does a good job in preventing diarrhoea. The degree of harm caused by foodstuffs generally considered dangerous is impressive.

The only surprise in the ranking of these items was the high rating of bottled water with or without carbonic acid. A possible noxious effect cannot be attributed to drinking from unclean glasses because beer and wine caused no harm.

Additionally, the survey indicated that only a small minority of travellers strictly adhere to the oft-repeated and sensible dietary recommendation (3, 5–8). This must be due to either lack of self-discipline or to lack of knowledge. Unpublished results of former studies show that over 90% of the travellers know at least the principles of the constantly repeated rules.

Motivating all travellers to follow these traditional rules would appear to be the proper approach in the future. Since simply recommending these rules to all travellers, however vigorously, will not guarantee that they are followed by the vast majority—it is justified to seek alternative solutions.

ACKNOWLEDGMENT

We are grateful to the management and the cabin crews of Balair for distribution of the questionnaires, to Miss Elisabeth Herold for preparation of the manuscript, to Michael Kaldeck for statistical advice, and to Mrs Beth Urech-Rankin for linguistic corrections.

REFERENCES

[1] Winkle S, Rohde R. Epidemiologische und seuchenprophylaktische Erfahrungen aus der 25jährigen Tätigkeit der Hamburger Salmonella-Zentrale. *Zbl Bakt Hyg I Abt Orig A* 1979; **243:** 392–411.

[2] Turner A C. Diseases of Travel. Travellers' Diarrhoea. *Trans Med Soc (Lond)* 1977; **92/93:** 64–70.

[3] Loewenstein M S, Balows A, Gangarosa E J. Turista at an international Congress in Mexico. *Lancet* 1973; **1:** 529–31.

[4] Chang T W. Traveler's Diarrhea. *Ann Int Med* 1978; **89:** 428–9.

[5] Ryder R W, Oquist C A, Greenberg H, *et al.* Travelers' Diarrhea in Panamanian Tourists in Mexico. *J Infec Dis* 1981; **144:** 442–8.

[6] Merson M H, Morris G K, Sack D A, *et al.* Travelers' Diarrhea in Mexico. *N Engl J Med* 1976; **294:** 1229–1305.

[7] Steffen R, van der Linde F, Gyr K, Schär M. Epidemiology of Diarrhea in Travellers. *JAMA* 1983; **249:** 1176–80.

[8] Gangarosa E J, Kendrick M A, Loewenstein M S, Merson H, Mosley J W. Global Travel and Travelers' Health. *Aviat Space Environ Med* 1980; **51:** 265–70.

[9] Ericsson C D, Pickering L K, Sullivanj P, DuPont H L. The Role of Location of Food Consumption in the Prevention of Travelers' Diarrhea in Mexico. *Gastroenterology* 1980; **79:** 812–6.

[10] Tjoa W S, DuPont L, Sullivan P, *et al.* Location of food consumption and travelers' diarrhea. *Am J Epidemiol* 1977; **106:** 61–6.

(Revised version received March 1984)