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Self-Reported Symptoms of Infection Among Travelers Departing From Sydney and Bangkok Airports

Anita E. Heywood, MPH,* Rochelle E. Watkins, PhD,† Sarika Pattanasin, MPH,‡ Sopon Iamsirithaworn, MD, PhD,‡ Kessarawan Nilvarangkul, PhD,§ and C. Raina MacIntyre, MBBS, PhD*

*School of Public Health and Community Medicine, University of New South Wales, Sydney, New South Wales, Australia; †Australian Biosecurity CRC, Curtin Health Innovation Research Institute, Curtin University of Technology, Perth, Western Australia, Australia; ‡Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Bangkok, Thailand; §Research and Training Center of Quality of Life of Working-Age People, Faculty of Nursing, Khon Kaen University, Khon Kaen, Thailand

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Background. Data on the burden of illness in travelers departing from both developing and developed countries within the Asia-Pacific region is scarce. We conducted a survey to assess symptoms of infection among travelers within the region.
Methods. A self-administered questionnaire was distributed to travelers departing Sydney airport, Australia, for destinations in Asia and departing Bangkok Airport, Thailand, for Australian destinations during the respective winter months of 2007. A two-stage cluster sampling technique was developed to ensure representativeness and a weighting was applied to the Sydney sample. Travelers were assessed for symptoms of infection (fever, sore throat, diarrhea, rash, and myalgia), travel activities, and social contact in the 2 weeks prior to departure.
Results. A total of 843 surveys was included in the final sample (Sydney 729, response rate 56%; Bangkok 114, response rate 60%). Overall, 45.6% of respondents were Australian residents and 26.7% were residents of countries in Asia. At least one symptom of infection was reported by 23.8% of respondents and 5.4% reported two or more symptoms of infection in the 2 weeks prior to departure. The proportion reporting symptoms was higher in those departing Bangkok compared to Sydney. Significant risk factors for the reporting of symptoms differed between residents and visitors departing each study site. Activities resulting in high rates of social contact prior to travel, particularly contact with febrile persons, were found to be independent predictors of reported symptoms.
Conclusions. Self-reported symptoms of infection were common in our sample of travelers. Infectious diseases in travelers can result in spread across international borders and may be associated with the frequency of social contacts and reported illness among travelers.

International travelers are at an increased risk of infectious diseases.[1] The most frequently reported health problems are traveler's diarrhea and respiratory tract infections which are generally mild and self-limiting.[2,3] However, more severe illnesses in travelers, such as influenza, malaria, dengue, and hepatitis A, are commonly reported.[4–7] While previous traveler studies report health problems in between 7.5 and 36% of travelers,[8–12] no comparable Australian or Thai data are available. Travelers transport infectious diseases across international borders and travel has been implicated as a factor in the global emergence and reemergence of infectious diseases.[13] The rapid dissemination of infectious diseases via travelers was clearly demonstrated by the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 and the current 2009 influenza A (H1N1) pandemic.[14,15]

The Asia-Pacific region has seen a higher than average growth in international tourist arrivals with 184.3 million international tourist arrivals in 2007, a 10.4% increase from 2006 compared to the global average increase of 6.6%.[16] Of departing flights from Australia in 2006, 51.7% were to destinations in Asia.[17] Despite increased tourist arrivals in the Asia-Pacific region, data on the burden of infectious diseases in travelers within this region are limited. Our study aimed to assess the proportion of travelers

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Corresponding Author and Reprint Requests: Anita E. Heywood, MPH, School of Public Health and Community Medicine, Faculty of Medicine, Level 3, Samuels Building, University of New South Wales, Gate 11, Botany Road, Kensington, NSW 2052, Australia. E-mail: a.heywood@unsw.edu.au

reporting symptoms of infection and identify significant independent predictors of symptoms of infection in a representative sample of travelers departing Sydney and Bangkok airports.

Methods

Cross-sectional surveys of travelers were conducted prior to their departure from international airports in Sydney, Australia, bound for destinations in Asia, and from Bangkok, Thailand, bound for Australia. A two-stage cluster sampling technique was developed at each study site to randomly sample travelers. In the first stage at the Sydney site, sample sizes for each destination were calculated based on the proportion of travelers departing Australia to destinations in South-Eastern and Eastern Asia.[17,18] Airline carriers were approached for permission to interview their customers and airlines were selected by their share of total passenger movements and represented both Australian and non-Australian carriers. Flight timetables of all approved airline carriers were obtained from airline websites and all flights to destinations of interest were sought. Two airlines declined to participate and were excluded from the study. While airline selection is unlikely to influence the outcomes reported, no data exist on traveler differences by airline. An interviewing timetable was devised to broadly represent flights on all available days and times of departure per carrier for each destination.

The second stage of the cluster sampling method involved the distribution of questionnaires to every fifth passenger joining the check-in queues of the selected flights. Bilingual interviewers attended check-in counters 3 hours before scheduled departure until 1 hour before departure. A similar method was employed at the Bangkok airport, with selected flights proportionate to the number of traveler arrivals at Australian airports from Thailand and representative of Thai, Australian, and other carriers. Overall, approximately 175 flights were sampled between July and September 2007 at the Sydney site comprising 2.7% of the flights to Asia during this period, and 13 flights between October and December 2007 at the Bangkok site, comprising 2.4% of the flights to Australia from Thailand during this period.

Eligible respondents were persons 18 years or older, departing on the day of interview. Transit passengers were excluded. The self-administered questionnaires were developed using simplified English and piloted at Sydney airport. The revised questionnaire was translated into Thai, Chinese, and Vietnamese and back-translated to ensure accuracy, and required 5 minutes to complete. Variables assessed included socio-demographic characteristics, travel characteristics, self-reported symptoms of infection, and social contacts on the day prior to departure. Contact with a febrile person and a range of activities suggestive of increased social contacts in the 2 weeks prior to departure were also collected. Symptoms assessed included fever, sore throat, diarrhea, myalgia, and rash. A definition of fever as a temperature $>37.7^{\circ}$C was given but no definition of other symptoms were provided.

The Sydney sample was weighted to reflect the proportion of passenger departures to each destination using aviation statistics,[17] providing a representative sample of travelers departing Australia for destinations in Asia. No weighting was applied to the Bangkok sample. Data were analyzed using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) and missing data were excluded from the analyses. The chi-squared test was used to assess statistical significance in bivariate analyses, and we considered a p value of <0.05 to be significant. Variables with a significance of <0.25 were considered for inclusion in logistic regression analyses and adequacy of sample sizes for logistic regression modeling were assessed using a method described by Peduzzi and colleagues.[19,20] The research was approved by the Human Research Ethics Committees of the University of New South Wales, Australia (08254), and the Ministry of Public Health, Thailand (3-2399-00051-49-4), as well as the relevant airport authorities.

Results

Study Sample and Travel Profile

A total of 878 surveys was collected at Sydney airport with a response rate of 56%. Of those, 149 (17.0%) were excluded from the weighted analysis as the reported flight destinations were outside Asia or unknown. The 729 weighted Sydney surveys represent 0.08% of the total travelers departing Australia for a destination in Asia during the study period.[17] The number of weighted respondents by flight destination is shown in Table 1. The majority of respondents were remaining in Asia (511/729, 70.1%), while 218 (29.9%) were also traveling to other regions, mainly in Europe. A total of 114 surveys were collected at Bangkok airport, with a response rate of 60%. The 114 surveys collected at Bangkok airport represent 0.8% of the total travelers departing from Thailand on flights to Australia during the study period.[21] The demographic and travel characteristics, the activities in the 2 weeks prior to departure, and social contacts on the day prior to departure by study site are shown in Table 2.

Symptoms

Self-reported symptoms of infection were common in travelers departing Australia and Thailand with a total of 200/843 (23.7%) reporting at least one of the five symptoms in the two weeks prior to departure and 46 (5.5%) reporting two or more of these symptoms. Overall, 3.4% of respondents reported fever, 14.8% reported sore throat, 5.6% reported myalgia, 4.3% reported diarrhea, and 2.1% reported rash. The reporting of fever, sore throat, and myalgia were not significantly different between sites; however, significant differences were reported for diarrhea (Sydney 3.0%, Bangkok 12.3%,

Table 1 Proportion of travelers departing Australia on flights to Asia in 2006 and the final weighted sample of travelers departing Sydney International Airport ($N = 729$)

Destination	Departing travelers from Australia, 2006	Proportion of departing travelers (%)	Weighted survey frequency
China	272,989	6.3	46
Hong Kong	847,692	19.5	142
Indonesia	243,097	5.6	41
Malaysia	546,957	12.6	92
Philippines	69,581	1.6	12
Singapore	1,788,849	41.2	300
Thailand	490,502	11.3	82
Vietnam	84,809	2.0	14
Total	4,344,476	100.0	729

$p < 0.001$) and rash (Sydney 1.6%, Bangkok 5.3%, $p = 0.03$). Respondents departing Bangkok reported higher rates of any symptom (32.5%; $p = 0.02$) and two or more symptoms (12.3%; $p = 0.001$) compared to respondents departing Sydney (22.4 and 4.4%, respectively).

Respondents who were departing from their country of residence were less likely to report any symptom of infection compared to departing visitors ($p = 0.04$). However, departure country residence was not significantly associated with the reporting of two or more symptoms of infection (4.5% residents, 6.1% visitors, $p = 0.3$). Compared to departing visitors, departing residents reported lower rates of diarrhea (residents 1.5%, visitors 6.1%, $p = 0.001$) and rash (residents 0.9%, visitors 3.0%, $p = 0.04$) but not other symptoms.

Female respondents were more likely to report sore throat (females 17.8%, males 12.3%, $p = 0.03$), myalgia (females 7.1%, males 4.0%, $p = 0.05$), and diarrhea (females 6.1%, males 2.7%, $p = 0.02$) than male respondents. A higher proportion of holiday travelers reported diarrheal symptoms (23/357, 6.4%) compared to other travelers (13/486, 2.7%, $p = 0.008$). Contact in the 2 weeks prior to departure with a person the respondent perceived as having a fever was reported by 78/843 (9.2%) respondents and was not significantly associated with country of departure ($p = 0.8$). A significant association was seen in reporting febrile contacts by those departing from their country of residence (13.1%) compared to departing visitors (6.5%, $p = 0.001$). Of the 78 respondents who reported contact with a febrile person, the majority reported that contact to be a household family member (35.9%), followed by a work colleague (26.9%) and a non-household family member or friend (23.1%). Other contacts included hotel guests and the patients of health care workers.

On multivariate logistic regression analysis, variables that were found to be independent predictors of reporting one or more symptoms were found to differ between Australian residents departing Australia, visitors departing Australia, and visitors departing Bangkok, and independent predictors identified from separate models are shown in Table 3. Activities associated with social contact reported prior to travel, particularly contact with febrile persons, were positively associated with the reporting of symptoms and found to be independent predictors on multivariate analysis.

Discussion

Symptoms of infection in the 2 weeks prior to departure were commonly reported in our cross-sectional sample of travelers within the Asia-Pacific region. Overall, approximately 1 in 4 respondents reported at least one and 1 in 20 reported two or more symptoms of infection, a significant finding considering the magnitude of air passenger movements within the region. In 2007, 5.8 million travelers departed Australia on flights to Asian destinations and a further 700,000 travelers departed Thailand for Australia.[21]

Reporting of symptoms was greater in respondents departing Bangkok. Studies from other regions have also shown significant differences in symptom reporting between travelers returning from destinations considered high and low risk.[8,12,22] No significant differences in symptoms were reported in a study of Taiwanese travelers returning from tropical and non-tropical regions of Asia.[10] Emerging infectious diseases, including drug-resistant strains, have been reported from both developing and developed regions, and studies of symptoms of infection in travelers from both these regions are of global public health interest.[23] Our study included both departing visitors and residents which may limit comparisons with other traveler studies. We found that departing residents were as likely to report two or more symptoms as departing visitors and more likely to report febrile contacts. However, independent predicators of reporting symptoms differed by these groups. The incidence of illness in travelers prior to commencing their trip has not been the focus of previous studies and our results support the carriage of infections in both departing and returning travelers. The general symptoms of infection assessed in this study are common to a range of globally prevalent diseases, and it can be expected that a proportion of travelers

Table 2 Traveler and trip characteristics by airport study site (total $N = 843$)

	Sydney ($N = 729$) *n*	Bangkok ($N = 114$) *n*	*p* Value
Mean age: y (SD)	36.6 (14.5)	37.3 (13.9)	0.7
Gender			
Male	385 (52.9%)	63 (55.3%)	0.6
Female	343 (47.1%)	51 (44.7%)	
Region of residence			
Australia	329 (45.4%)	55 (48.7%)	<0.001
South-East Asia	115 (15.9%)	12 (10.6%)*	
Eastern Asia	96 (13.3%)	2 (1.8%)	
Other Western†	170 (23.3%)	29 (25.4%)	
Other non-Western	18 (2.5%)	15 (13.2%)	
Resident of birth country	529 (72.6%)	87 (80.6%)	0.08
Purpose of travel			
Holiday	287 (39.4%)	70 (61.4%)	<0.001
Business/employment	163 (22.4%)	15 (13.2%)	
Visiting friends/relatives	182 (25.0%)	14 (12.3%)	
Other/not stated	97 (13.3%)	15 (13.2%)	
Duration of travel			
<2 weeks	230 (31.9%)	48 (43.2%)	0.01
2 to <4 wk	148 (20.5%)	20 (18.0%)	
1 to < 3mo	161 (22.3%)	15 (13.5%)	
3–12 mo	92 (12.8%)	21 (18.9%)	
>12 mo	90 (12.5%)	7 (6.3%)	
Travel group			0.003
Travel alone	392 (57.3%)	45 (42.1%)	0.5
Travel with others	292 (42.7%)	62 (57.9%)	
Travel with children (<16 y)	67 (9.7%)	9 (7.9%)	
Number of countries visiting			
One country	355 (49.7%)	37 (32.5%)	<0.001
Two countries	241 (33.7%)	43 (37.7%)	
Three or more countries	119 (16.6%)	34 (29.8%)	
Activities in the past 2 wk		44 (38.6%)	
Traveled outside city	149 (20.4%)	18 (15.8%)	<0.001
Visited a rural/remote area	57 (7.8%)	56 (49.1%)	0.005
Travel on domestic flights	267 (36.6%)	43 (37.7%)	0.01
Long-distance train travel (>2 h)	149 (20.4%)	67 (58.8%)	<0.001
Visited a crowded venue	302 (41.4%)	16 (14.0%)	0.001
Attended a conference/convention	123 (16.9%)		0.4
Reported close contact with ≥ 10 people day prior to departure‡			
Children (<16 y)	15 (2.1%)	5 (4.4%)	0.1
Young adults (16–35 y)	115 (15.8%)	21 (18.4%)	0.5
Adults (36–55 y)	105 (14.4%)	23 (20.2%)	0.1
Older adults (>55 y)	65 (8.9%)	12 (10.5%)	0.6

*Thai residents represented 6/114 (5.3%) of respondents departing Bangkok airport.
†Other Western includes European, North American, and New Zealand residents.
‡Close contact defined as a face-to-face two-way conversation with another person for at least 10 min.

departing from their country of residence will report symptoms of infection.

Our findings also highlight the importance of social contact and human behavior in the spread of infectious disease during travel. We acknowledge that causality cannot be concluded from a cross-sectional study, and social contacts on the day prior to interview, as obtained in this study, are not likely be causally related to the symptoms reported in the 2 weeks prior to interview. However, the assessment of recent behavior produces the least recall bias while providing a proxy measure of typical levels of social contacts over the 2 weeks prior to departure.

Sore throat was the most common symptom reported in our study. Comparable studies report a low prevalence of respiratory symptoms in cross-sectional samples of travelers ranging from 2.2% to 4%.[8–10] Fieldwork during the winter months, when rates of respiratory infections are greater, may explain the high level of reporting in our study. Sore throat is a symptom of a range of pathogens that are common worldwide, which may account for the similar rates of sore throat found between study sites. This study also provides an estimate of the expected rate of fever among travelers which may be useful in an emerging infectious disease situation in which airport screening is implemented to identify ill travelers using symptom self-reporting

Table 3 Factors significantly associated with reporting one or more symptoms of infection on multivariate analysis, reported separately by traveler group (total $N = 843$)

Factor	Proportion reporting symptoms	Odds ratio	95% CI	*p* Value
Australian residents departing Sydney ($N = 329$)				
Contact with febrile person*				
No	52/285 (18.2%)	1		
Yes	15/44 (34.1%)	2.10	1.0–4.2	0.04
Number of close contacts day prior to departure				
Less than 10 persons	39/238 (16.4%)	1		
More than 10 persons	29/91 (31.9%)	2.27	1.3–4.0	0.005
Visitors departing Sydney ($N = 399$)				
Gender				
Male	33/194 (17.0%)	1		
Female	63/205 (30.7%)	2.04	1.3–3.4	0.005
Attended crowded venue*				
No	40/206 (19.4%)	1		
Yes	56/193 (29.0%)	1.66	1.0–2.7	0.04
Long-distance train travel*				
No	47/279 (16.8%)	1		
Yes	49/120 (40.8%)	3.25	2.0–5.3	<0.001
Visitors departing Bangkok ($N = 107$)				
Contact with febrile person*				
No	28/97 (28.9%)	1		
Yes	9/10 (90.0%)	22.18	2.7–183.3	0.004

*Activities or contacts in the 2 weeks prior to departure.

methods. Reported fever in our study was within the range (0.8%–3%) reported in similar studies of travelers.[8,10,24] The detection of symptomatic travelers at international borders is an integral component of controlling the international spread of infectious diseases of international public health importance such as SARS and pandemic influenza.[25] During the 2009 influenza A (H1N1) pandemic, border control measures at international airports included self-reporting of symptoms on health declaration cards. Entry screening of travelers during the SARS outbreak at airports in Canada, China, and Singapore found approximately 0.03% of travelers reported symptoms on health declaration cards.[26] During emergency situations factors such as exit screening, the deferring of travel, and false statements are likely to influence the proportion of travelers self-reporting.[26,27] This study, and other similar studies reporting fever in travelers, provide baseline data for border screening during emergency situations.

Published global studies report a risk of diarrhea in travelers ranging from 0.3% to as high as 60%.[9,10,28–30] Studies conducted in travelers to Thailand between 1975 and 1984 reported rates of travelers' diarrhea of between 22 and 57%,[2] whereas a recently published large-scale survey of travelers departing from Thailand over a 14-month period reported an overall attack rate of 6% to 10% across seasons, with results differing significantly by nationality.[31] Rates of diarrhea found in our sample of travelers departing Thailand are similar to this more recent estimate. The lower reported rate of diarrhea among more recent studies may be attributed to a decline in the incidence of diarrheal diseases in Thailand over the last two decades[32] and significant progress in reducing the burden of diarrheal diseases in the region overall.[33] Global studies of the incidence of traveler's diarrhea have found the risk of diarrheal disease to be inversely proportionate to the income level of the country.[29] Thailand has seen strong economic development, and associated improvements in sanitation and water supply may explain the decrease in reported traveler's diarrhea in visitors to Thailand over the last three decades. Improvements in food and water hygiene have also been demonstrated by Thailand's changing hepatitis A epidemiology in which outbreaks of hepatitis A in the adult population have been reported, indicating fewer Thai residents are infected during childhood.[32] Travelers in our survey also reported diarrhea after travel to Australia. Although severe gastrointestinal illnesses are not common in Australia, mild diarrheal illnesses are common with a national gastroenteritis survey reporting 0.9 cases of gastroenteritis occurring per person per year.[34]

A more detailed assessment of common symptoms of infection, especially respiratory symptoms, across both study sites would have been a useful addition to our survey. A self-administered questionnaire design, although appropriate to maximize the response rate in high volume airport surveys, limits the amount of detail obtainable and is also subject to recall bias. No case definitions were provided and symptoms were

not objectively verified. Data on the reliability of self-reported infectious symptoms are scarce; however, one study has shown a high congruence between interview data and physician diagnoses ($\kappa = 0.77$) and high test–retest reliability ($\kappa = 0.76$).[35] While the reported symptoms in our study are suggestive of an infectious etiology we cannot rule out non-infectious causes due to the non-specific nature of these symptoms. Reporting of two or more symptoms of infection may be a more reliable indicator of an infectious etiology for this purpose, and larger sample sizes are required to investigate the utility of this indicator. A larger sample of visitors departing Bangkok, as well as sampling travelers to other Asia-Pacific destinations would also have further strengthened our results.

Our results also show that approximately 1 in 10 respondents reported a possible contact with a person with a fever, and that those residents departing Australia and visitors departing Thailand who reported febrile contacts were more likely to self-report symptoms. Assuming effective contact with a febrile person, these respondents may be at higher risk of transmitting infection while traveling. Differences in travelers' knowledge of their close contacts may explain the lack of independent significance of febrile contact in visitors departing Sydney. Resident respondents may be more likely to know their close contacts and have a better awareness of their contacts' health status compared to travelers, and travelers to countries of higher disease endemicity may be more aware of the health of their close contacts. It is likely to be difficult for people to determine when they have been exposed to infection or to recall such events, and therefore such exposures are likely to be underestimated. During SARS, 56% of imported probable or suspected SARS cases developed symptoms after entry[26] and the inclusion of self-reported contact may assist in algorithms for border control during emergency situations.

Conclusion

The results from our representative survey contribute to the current global data on the burden of illness in travelers, particularly from the Asia-Pacific region, where few studies have been published. The proportion of travelers reporting common symptoms of infection is similar to studies from other regions and is consistent with models of disease transmission in that contact with a febrile person was the most important predictor of reported symptoms. The significance of febrile contacts in symptom reporting among both departing residents and visitors in our study suggests that the assessment of social contacts may provide a useful means to assess the risk of infectious disease in travelers.

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Declaration of Interests

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