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Knowledge, attitude and recommendations for practice regarding dengue among the resident population of Queensland, Australia

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ABSTRACT

Objective: To investigate levels of awareness of dengue among the inhabitants of Queensland (QLD), a dengue-prevalent state in the north east of Australia.
Methods: A computer-assisted telephone interviewing survey was conducted in mid 2014. A total of 1 223 randomly selected respondents (≥ 18 years) across QLD completed a structured questionnaire covering all aspects of dengue.
Results: 97.55% had heard of dengue and participated further. Among them, 54.70% had travelled overseas (48.11% to dengue-risk countries) in the last five years. A total of 94.47% said transmission is by mosquito bite. In addition, 84.83% knew of current transmission of dengue in QLD, while 80.97% knew the focus is Far North and North QLD. Furthermore, 2.35% and 8.97% had experienced an infection in their life or that of their immediate family/partner, respectively. 85.03% identified correctly at least one means of prevention. A total of 69.72% advised to use insect repellent, wear covered clothing and avoid visiting mosquito-prone areas while 20.93% advised fumigation and clearing water containers around residences. There was a significant difference ($P < 0.05$) between residents of South East QLD and the rest of QLD regarding knowledge of prevention. However, such awareness was not affected significantly by overseas travel ($P > 0.05$).
Conclusions: Although many people throughout QLD have heard of dengue, about 15% appear unaware of local transmission, its symptoms and of methods to reduce risk of infection. A lack of knowledge regarding prevention of mosquito breeding is evident in South East QLD, where dengue is not currently reported. The study suggests that future dengue awareness campaigns should target communities in both endemic and potentially endemic areas throughout Queensland.

1. Introduction

Dengue, a mosquito-borne viral disease of humans, has in recent years drawn increased worldwide public health concern. Over 3.6 billion inhabitants of the tropics and subtropics are currently at risk of infection [1], with an estimated 390 million dengue infections reported per year in around 130 countries worldwide [2,3]. The causative agent of the disease is the enveloped, icosahedral, single stranded positive-sense RNA virus dengue, a member of the family Flaviviridae and genus *Flavivirus*. Based on differences in antigen neutralization tests five serotypes (DENV-1 to DENV-5) are now recognized [4]. The mosquito species that are principally responsible for dengue transmission, *Aedes aegypti* and *Aedes albopictus* [5], are distributed mainly in tropical localities, including the Asia–Pacific region, in parts of which it is endemic [6]. The nature of disease ranges from mild self-limiting illness, dengue with warning signs (abdominal pain, persistent vomiting, fluid accumulation, mucosal bleeding, lethargy, increasing haematocrit with decreasing platelets), to severe dengue (dengue with severe plasma leakage, severe bleeding, or organ failure) [7].

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The study protocol was performed according to the Helsinki declaration and approved by the Human Ethics Research Review Committee of Central Queensland University. A confidentially agreement was signed by each survey interviewer and informed verbal consent was obtained from each participant.

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Despite decades of intensive research, the present unavailability of an effective antiviral drug and/or licensed vaccine makes dengue a major global public health priority [8,9].

Dengue is an emerging concern in Australia. There have been occurrences of infection in Queensland (QLD) for many years, with local transmission resulting in multiple outbreaks in Northern QLD [10,11]. A major outbreak in March 2009 and continuing sporadic incidences have further alerted state authorities to the public health risk posed by dengue. A large outbreak of DENV-2 in 1992–93 has left a sustained potential threat. In the intervening period, there have been more than 40 outbreaks comprising 3 086 confirmed cases and causing three deaths [12]. The number of overseas travel-associated cases of dengue, almost 10 times higher than locally acquired, continues to increase annually: 1 390 in 2011–12; 1 133 in 2010–11; 593 in 2009–10; 350 in 2007–08 [13,14].

In response to the real and perceived threat to the resident population of QLD, the State Government has launched successive dengue management plans, the most current iteration of which concludes soon [15]. However, risk of outbreak is always amplified when communities are not aware of the disease. In spite of the long history of dengue in this state, it was our anecdotal belief that local people lack sufficient awareness of the virus, its route of transmission, and the disease it causes. Thus, the aim of the present survey was to investigate knowledge of and attitude towards dengue among the people of QLD. Awareness level is an extremely important factor in determining a strategy for future public health policies. Without this information, scarce resources for rural and regional health may easily be directed towards information campaigns that do little to alter the community's current understanding of preventive measures. Hence, this study holds pragmatic value to policy makers of QLD for implementing a public health information drive to assist in the reduction, and ultimately prevention, of dengue in QLD. Also, it provides a useful point of reference for health educators in countries of the Western Pacific, North America and Europe, where, similar to Australia, dengue poses an increasing threat.

2. Materials and methods

The survey was conducted by a highly experienced team of trained telephone operators from the 2014 Queensland Social Survey (QSS 2014). This was the tenth annual state-wide survey administered by the Population Research Laboratory (PRL) based at the Rockhampton campus of Central Queensland University. The QSS is an omnibus-style survey of households in QLD that is acknowledged to provide a structured research framework that serves as a reliable, credible, and relatively low-cost data collection vehicle.

2.1. Survey instrument

The survey consisted of three components: 1) a standardized introduction; 2) socio-demographic questions; and 3) questions that specifically addressed the interests of the researchers participating in the study, including awareness of dengue which constituted our research study. For the second component, information was requested on household composition, gender, age, marital status, highest level of education, household income, religion, ethnicity, employment status, occupation, home ownership and sample area. For the third component, a structured questionnaire of nine standard questions, carefully designed to cover all aspect of awareness of dengue among residents of QLD, was used. Our research hypothesis was that awareness of dengue is influenced by the geographical location of residence and overseas travel history of an individual.

The set of survey questions focused on dengue epidemiology in the state, mode of transmission and vector control methods along with participants' place of origin and travel history. Trained interviewers trialled the entire questionnaire on 68 households in QLD selected at random. Minor amendments to improve text of questions were made after review of pre-test frequency distributions and feedback from interviewers (*e.g.* comments on effect of question order on responses, inappropriate response categories, ambiguous wording).

Approval for QSS 2014 was received from the Human Ethics Research Review Committee at Central Queensland University prior to its conduct with the QLD general public. The authorized application was Project H13/06-120 Queensland Social Survey 2014.

2.2. Sampling design

For sampling purpose the state of QLD was delineated into two areas for telephone interviewing: South East QLD (SEQ); the remainder of QLD (non-SEQ). QLD is the second largest and third most populous state in Australia. Among an estimated 4.75 million population, more than two thirds (3.20 million) live in SEQ, which includes the state capital Brisbane, and the metropolitan regions of Gold Coast, Sunshine Coast and West Moreton. The remainder of QLD is sparsely populated and regional or rural [16]. In order to permit the analysis of each area as a separate entity, a minimum sample size of 400 for each sub-region was deemed necessary.

A two-stage selection process was used to register participants: selection of households and selection of respondent gender within each household. The target population designated for telephone interviewing was all persons 18 years of age or older who, at the time of the survey, were living in as their usual place of residence an abode in QLD that could be contacted via a direct-dialled, landline telecommunications connection. A random selection approach assured that each respondent had the same likelihood of being contacted. The PRL used a telephone database of randomly generated landline telephone numbers which had been selected using postcode parameters and washed to remove known non-residential and non-working numbers. Each household was randomly pre-selected as either a male or female household. Within the household, one eligible person was selected as the respondent for the interview. If there was more than one male/female in the household then the male/female that had the most recent birthday was selected. If there was no one of the pre-selected gender residing in the house then the house was designated not qualified.

2.3. Data collection

QSS 2014 was performed utilising a twenty-station computer-assisted telephone interviewing (CATI) system linked to a local area network at the PRL. This facility enabled information

exchange between interviewing PC stations and a supervisor hub connected by a shared file server. Supervisors monitored each call deposition, after which data were edited, validated and compiled for analysis.

Following the pilot test, the sample database was uploaded to the CATI system which assigns telephone numbers to interviewing stations. Instructions and questions were shown on the PC screen to the interviewer who spoke to the respondent by telephone. As interviewers entered the responses provided into the PC while each interview took place, it was possible to monitor continually closed-ended responses. All PRL staff involved in the study were required to sign a confidentiality statement before the commencement of data collection.

Interviewing took place between 29 July and 31 August 2014. Interviews were conducted between the hours of 10:30–14:30 Monday, Wednesday and Friday, 16:30–18:30 Monday to Friday, and 12:00–16:00 on Saturday and Sunday. If interviewers were unsuccessful in establishing contact on their first call, a minimum of five call-back attempts was made. Upon making contact, interviewers identified themselves and then asked the screening questions for selecting the respondent. The average complete interview length was 29 min.

2.4. Data analysis

The estimated sampling error for the total sample, at the 95% confidence level, was ± 2.8%, 19 times out of 20. Respondents 65 years and older were overrepresented (33.6%) while there was under sampling of the under 35 age categories (7.8%). Gaining adequate participation of younger respondents when conducting CATI surveys using randomly generated landline telephone samples has become more difficult as this demographic has been particularly affected by the shifting pattern towards preference for exclusive use of mobile phones. However, recent studies have shown that the exclusion of mobile phone only households may currently have only low or non-significant impacts upon estimates obtained using these data [17,18].

The collected data were tabulated and analysed using SPSS version 19. A *Chi*-square test (χ^2) was performed using 95% confidence intervals (*CI*) in order to determine the association between overseas travellers and non-travellers, and between SEQ and non-SEQ residents with respect to their knowledge of dengue and its prevention.

3. Results

3.1. Socio-demographic characteristics of respondents

Of 3438 individuals contacted for the QSS 2014, 1223 completed the survey, a response rate of 35.57%. This is in line with the response rate for general household telephone surveys in recent years [19]. A total of 814 (66.56%) householders were sampled from SEQ and 409 (33.44%) from non-SEQ. These sample sizes are closely proportional to the state populations they represent, as indicated by the most recent Australian Bureau of Statistics census data [20]. An equal proportion of males and females with a mean age of (57.2 ± 15.5) years participated in the study. About 77.76% (951/1223) of respondents were born in Australia; regardless of the country of birth, the mean time spent living in Australia was 55.35 years. Table 1 shows the major socio-demographic characteristics of respondents in the sample areas.

Table 1
Major socio-demographic characteristics of survey respondents.

Category	Variable	Whole QLD (%)	South East QLD (%)	Non-South East QLD (%)
Gender	Male	50.0	49.9	50.1
	Female	50.0	50.1	49.9
Age	Mean ± SD	57.2 ± 15.5	57.6 ± 15.4	56.4 ± 15.6
Marital status	Married	67.9	68.6	66.7
	De facto	5.9	5.7	6.4
	Separated/Divorced	8.4	7.3	10.5
	Widowed	6.7	6.5	7.1
	Single	10.9	11.8	9.0
Country of birth	Australia	77.8	74.3	84.6
	Other	22.2	25.7	15.4
Education status	1–10 years	23.5	20.8	28.9
	11–12 years	21.5	21.9	20.8
	13–14 years	12.3	10.8	15.4
	15+ years	41.7	45.5	34.2
Employment status	Employed full-time	36.9	34.4	41.8
	Employed part-time/casual	18.3	19.3	16.4
	Unemployed	3.9	4.0	3.7
	Retired/Pensioner	35.9	36.8	33.9
	Student	1.1	1.1	1.0
	Home duties	3.5	3.9	2.7
Household income	Nil-$26000	12.3	10.2	16.6
	$26001–$52000	10.9	9.8	13.0
	$52001–$100000	16.8	16.7	16.9
	> $100000	23.5	24.0	22.5
	Did not report income	36.5	39.3	31.1

In whole QLD, n = 1223; In South East QLD, n = 814; In Non-South East QLD, n = 409.

3.2. Travel history of respondents

54.70% (669/1 223) of all participants had travelled overseas in the last five years. Among SEQ inhabitants, 60.81% (495/814) provided an overseas travel history, while only 43.52% (178/409) of non-SEQ respondents did similarly ($P < 0.05$). Respondents collectively reported visiting 106 countries in the last five years. Nearly half (48.11%; 51/106) of the nations visited by participants are listed as dengue-risk countries by the World Health Organization. The principal destinations for travel are depicted in Figure 1.

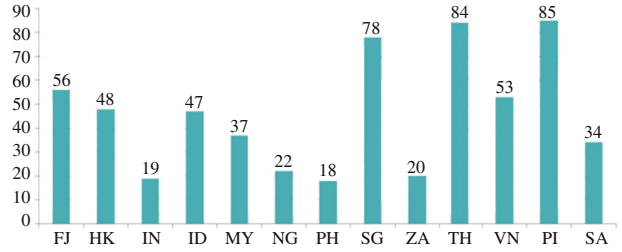

Figure 1. Dengue-risk countries to which QLD residents travelled in the last five years.
FJ: Fiji; HK: Hong Kong; IN: India; ID: Indonesia; MY: Malaysia; NG: Papua New Guinea; PH: Philippines; SG: Singapore; ZA: South Africa; TH: Thailand; VN: Vietnam; PI: Pacific Islands; SA: South America. Numbers signify total of individual responses per nation, region or continent.

3.3. Respondents' knowledge of dengue: symptoms and transmission of infection

A total of 97.55% (1 193/1 223) of participants claimed knowledge of dengue and so were asked further questions. About 2.35% (28/1 193) of these respondents had experienced dengue infection; 1.28% (10/793) and 4.5% (18/400) from SEQ and non-SEQ, respectively (Table 2). About 8.97% (107/1 193) indicated that their partner or an immediate family member had been infected. In addition, 46.02% (549/1 193) of participants identified correctly the typical symptoms of dengue, such as fever, rash, headache, muscle and joint pain. Furthermore, 84.83% (1 012/1 193) knew of the current transmission of dengue in QLD, and 80.97% (966/1 193) identified correctly the major areas in the state where past epidemics of dengue have occurred. The response rate was in following order: Far North QLD > North QLD > Central QLD. There was no significant difference in the views of respondents from geographically distinct locations ($P > 0.05$).

Among these, 94.47% (1 127/1 193) responded correctly that dengue is transmitted by mosquito bite, 3.27% (39/1 193) did not know the mode of transmission, while the remaining 2.26% (27/1 193) offered the view that it is caused by bad food, water, coughing or unwashed hands. Regarding knowledge of transmission, no significant difference was found between inhabitants of SEQ and non-SEQ, and between overseas travellers and non-travellers ($P > 0.05$) (Table 3).

3.4. Respondents' knowledge of dengue: control and prevention of infection

3.10% participants (37/1 193) did not give a response regarding vector control, so the sample population for this question was reduced to 1 156. In addition, 7.01% (81/1 156) of respondents expressed no knowledge of vector control, but 85.03% (983/1 156) had at least an idea of suitable methods, identifying correctly at least one appropriate means of prevention. About 69.72% (806/1 156) responded to avoid mosquito bites by applying insect repellent, wearing covered clothing, avoiding visiting mosquito-prone areas, while 20.93% (242/1 156) showed an appreciation of vector control by disturbance of mosquito breeding (clearing water containers around, and fumigation of residential sites). Inhabitants of SEQ were

Table 2
Survey respondents' experience of dengue infection.

Dengue infection	[a]South East QLD resident		[b]Non-South east QLD resident	
	n (%)	95% *CI*	*n* (%)	95% *CI*
Immediate family/partner	65 (8.20)	± 1.88	42 (10.50)	± 2.99
Work colleague	32 (4.04)	± 1.35	17 (4.25)	± 1.98
Close friend	40 (5.04)	± 1.50	23 (5.75)	± 2.28
Social acquaintance	40 (5.04)	± 1.50	24 (6.00)	± 2.31
Yourself	10 (1.26)	± 0.78	18 (4.50)	± 2.02
Nobody	573 (72.26)	± 3.07	254 (63.50)	± 4.69
Mixed response	10 (1.26)	± 0.78	11 (2.75)	± 1.61
Don't know/unsure	23 (2.90)	± 1.15	11 (2.75)	± 1.61
Total respondents (1193)	793 (100)		400 (100)	

[a] *vs.* [b] $P > 0.05$ for all categories.

Table 3
Survey respondents' knowledge of dengue transmission.

Mode of transmission	[a]Overseas traveller [*n* (%)]	[b]Overseas non-traveller [*n* (%)]	[c]South East QLD resident [*n* (%)]	[d]Non-South East QLD resident [*n* (%)]	Total [*n* (%; *CI*)]
Mosquito bite	625 (95.13)	502 (93.66)	741 (93.44)	386 (96.50)	1 127 (94.47; ± 1.29)
Bad food or water; coughing & sneezing; unwashed hands	15 (2.28)	12 (2.24)	22 (2.77)	5 (1.25)	27 (2.26; ± 0.85)
Don't know/unsure	17 (2.59)	22 (4.10)	30 (3.78)	9 (2.25)	39 (3.27; ± 1.01)

For overseas traveller, $n = 657$; For overseas non-traveller, $n = 536$; For South East QLD resident, $n = 793$; For non-South East QLD resident, $n = 400$; In total, $n = 1\,193$. For all modes, [a] *vs.* [b] $P > 0.05$; [c] *vs.* [d] $P > 0.05$.

significantly less knowledgeable of dengue prevention with regard to eliminating vector breeding sites than residents of other regions of QLD ($P < 0.05$). There was no such difference observed between the knowledge of overseas travellers and non-travellers ($P = 0.23$) (Table 4). Of note, 2.34% (27/1 156) of participants stated a dengue vaccine as a means of prevention.

Table 4

Survey respondents' knowledge of dengue prevention.

Vector control methods	[a]Overseas traveller [*n* (%)]	[b]Overseas non-traveller [*n* (%)]	[c]South East QLD resident [*n* (%)]	[d]Non-South East QLD resident [*n* (%)]	Total [*n* (%; *CI*)]
Prevent mosquito bites	445 (69.75)	361 (69.69)	559 (72.98)	247 (63.33)	806 (69.72; ± 2.65)
Prevent mosquito breeding	130 (20.38)	112 (21.62)	124 (16.19)	118 (30.26)	242 (20.93; ± 2.35)
Vaccine	20 (3.13)	7 (1.35)	21 (2.74)	6 (1.54)	27 (2.34; ± 0.86)
Don't know/unsure	43 (6.74)	38 (7.34)	62 (8.09)	19 (4.87)	81 (7.01; ± 1.47)

For overseas traveller, $n = 638$; For overseas non-traveller, $n = 518$; For South East QLD resident, $n = 766$; For non-South East QLD resident, $n = 390$; In total, $n = 1156$. For all modes, [a] *vs.* [b] $P < 0.05$; [c] *vs.* [d] $P < 0.05$.

4. Discussion

Outbreaks of dengue in Australia date back as far as the late 19th century and have been reported across the country in Northern Territory, Queensland, New South Wales and Western Australia [21]. However, currently local transmission occurs within QLD only [15]. Despite this long history of dengue in Australia, to the best of our knowledge, this is the first study to be conducted to assess knowledge and attitude regarding dengue among the resident population of Australia.

The present survey found that 97.55% of participants resident in QLD had heard of dengue. Of these individuals, 94.47% knew about mosquito transmission of infection. This level of awareness is higher than that reported for inhabitants of other nations: Northern Thailand, 67% [22], Nepal, 77% [23], and India, 90% [24]. Each of these countries is dengue-endemic [1,2], but is recognized as having a low human development index (HDI) [25]. Comparing our result with these findings assumes that peoples' knowledge may be associated with the development index of the country in which they live, as HDI influences directly the education system, technology and media of the nation. A more valid comparison would be with high HDI countries for which dengue is endemic. As Australia is unusual, but not unique, in being a highly developed nation in which local transmission of dengue occurs, this information is not currently available. Similar studies to the one reported here would be required elsewhere.

Over four fifths (84.83%) of participants in the survey were cognisant of the ongoing prevalence of dengue in QLD and almost all these respondents (80.97%) also knew that its occurrence and local transmission is particularly high in the north of the state. The coverage by local, state and national Australian media (newspaper, television, radio and social media) of previous dengue outbreaks in QLD will likely have raised awareness of such residents to the geographical distribution of dengue in the state. The principal vector for dengue transmission, *Aedes aegypti*, is present in Far North and North QLD but is much less common further south. Thus, at present outbreaks are restricted largely to these regions but will presumably occur with increasing frequency elsewhere in future if the range of the vector extends as a consequence of global warming. Local transmission is possible and occurs after the initial introduction of dengue into the community by a viraemic traveller, visiting or returning from overseas or even elsewhere in QLD, who is infectious to mosquitoes [26]. Potential secondary vectors are found only in Far North QLD; to date *Aedes albopictus* has been identified only in the Torres Strait Islands [27] and *Aedes scutellaris* in both the Torres Strait Islands and Cape York [28].

A total of 2.35% of participants had personally experienced dengue while 8.97% knew of an infection to their partner or immediate family member. This report links indirectly to the notified incidence rate of dengue in QLD, for which the current population is 4.75 million [16]. The total number of recorded dengue cases in QLD in the last 10 years is approximately 2 000 [15]. Thus, it may be implied from our survey result that many participants were infected with dengue over a decade ago, most probably during dengue outbreaks of 1992–93 and 1997–99 [10,12].

46.02% of participants identified correctly the commonly recognized symptoms of dengue, such as fever, rash, headache, muscle and joint pain. This total compares poorly with the understanding of participants of similar surveys conducted in Nepal (> 80%) [23], India (> 70%) [24], Malaysia (> 80%) [29] and Brazil (> 66%) [30]. These countries are dengue-endemic and most people live in a traditional family unit in a closely clustered neighbourhood as compared to the more isolated residences in QLD, especially in regional and rural areas. Hence, the greater understanding of the signs and symptoms of disease by people in these tropical locations may be based on their close observation of dengue infection contracted by their family members and/or neighbours.

More than half (54.70%) of participants had travelled overseas in the last five years. In total, 51 of 106 nations visited are considered officially as dengue-risk countries according to current guidelines for dengue control issued by the World Health Organization [7]. These include Pacific Islands, Singapore, Thailand and Indonesia, the last two of which are considered hyper-endemic for dengue with regular reporting of outbreaks since 2000 [31]. In Singapore, the number of clinical cases is rising rapidly and is anticipated to exceed 1 000 per week during high season [32]. At present, dengue is not a disease endemic to Australia with local outbreaks confined to North QLD. Since 1990 there has been almost continual annual transmission in QLD arising from infections introduced by incoming travellers [33]. When a viraemic person enters a vector-prevalent area like North QLD, they become a potential source for transmission, which may lead to a local outbreak. Currently, most imported cases originate from Indonesia, Thailand, Philippines and Papua New Guinea [13,33]. An improved general knowledge of dengue would make travellers more likely to recognize its disease symptoms, and therefore

to seek medical advice if returning with a febrile illness from overseas, particularly a dengue-endemic region.

85.03% of survey respondents had some awareness of appropriate measures to take for dengue control. Among these, around two thirds advised prevention of mosquito bites, but only one in five conveyed the concept of vector control by limiting their breeding. Residents outside SEQ were significantly more likely to have an awareness of dengue prevention and control than those individuals living in SEQ, where there is no prevalence of dengue. This indicates that the geographical location of an individual's permanent place of residence influences their awareness of the risk to their local community of dengue infection. 2.34% of participants mentioned dengue vaccination, even though a commercially available preparation is not currently available. While this may be due to expectation of the existence of a vaccine, it may be that in part this shows awareness through the news media of drug and vaccine trial research, especially that taking place within QLD [34,35].

Of particular interest, there was no notable difference in the general knowledge of dengue between those participants of the survey who had travelled overseas, even to dengue-endemic regions, and those who had not. This finding did not support our hypothesis at the outset of the study, that a person's awareness of dengue is influenced by their overseas travel history. This is of concern since prompt presentation for medical care and notification of public health authorities by returned travellers with dengue would effectively reduce the number of dengue outbreaks each year in QLD.

Although many people surveyed had heard of dengue, most of them were unaware of the symptoms of disease and possessed inadequate knowledge of preventive methods or vector control. No significant difference was found in responses to dengue awareness questions (mode of transmission and dengue control) between overseas travellers and non-travellers. However, there was a direct correlation between the dengue prevalence of the geographical location in QLD of a person's permanent residence with their knowledge of dengue control methods. Annually, travel-associated and some locally acquired dengue cases have been reported from northern parts of QLD. Public awareness of, and preparedness for, incidences or outbreaks of any disease can be heavily influenced by communication between neighbourhood residents. Sharing of information formally among people in a community or in the work place, or more informally among family and friends are effective means of knowledge transfer, especially in rural and remote locations. In addition, local media outlets make the public aware of issues of regional relevance. However, the results of this survey suggest that the efficacy of dissemination of relevant and correct information by newspapers, television and radio should be reconsidered in order to increase public understanding of dengue in QLD.

The results of this survey indicate that around 15% of QLD residents do not have any awareness of the prevalence of dengue within the state. Similarly, approximately 15% of the population would appear not to have any knowledge of its symptoms of illness, or means of its prevention. This knowledge gap may not be entirely surprising given that dengue is not an emergency public health issue in QLD and the focus of outbreaks lies in sparsely populated northern tropical regions, a considerable distance from the higher population density of SEQ. It is thought that past and present public health awareness campaigns have targeted only areas of the state where the potential for establishment of the disease has or currently exists [5,15]. Today, dengue vector mosquitoes are found as far south as Rockhampton which lies on the Tropic of Capricorn [13,15].

Nevertheless, particularly given the occurrence of travel-associated cases the outcomes of this study indicate the need for effective dengue awareness campaigns throughout QLD. International travellers, the vast majority of whom depart Australia from airports in Brisbane or other major metropolitan areas, should be made aware of the risk of contracting dengue overseas, since travel-associated cases are the major source of infection in QLD.

This survey provides an evidence-based indication of the level of knowledge of the resident adult population of QLD in relation to dengue. In considering plans to implement preventative measures against dengue, public health policy makers may regard this study as a reference to design revised or new strategies to control dengue in areas of transmission.

Conflict of interest statement

We declare that we have no conflict of interest.

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