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BRIEF REPORT

Comparison of the Epidemiological Aspects of Imported Dengue Cases between Korea and Japan, 2006–2010

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Abstract
To compare the epidemiological characteristics of dengue cases imported by travelers or immigration in both Korea and Japan, we determined dengue incidence and related risk factors. During 2006–2010, 367 and 589 imported dengue cases were reported in Korea and Japan, respectively. In Korea, the presumptive origins for the dengue infections were Southeast Asia (82.6%), Southern Asia (13.9%), Eastern Asia (1.1%), South America (0.3%), Central America (0.3%), Africa (0.3%), and other countries (1.6%). In Japan, the origins of the infections were Southeast Asia (69.8%), Southern Asia (20.0%), Eastern Asia (1.7%), South America (2.5%), Central America (1.2%), Africa (1.2%), Oceania (2.4%), and other countries (1.2%). In both countries, more dengue cases were reported for men than for women ($p < 0.01$), and those aged 20–30 years accounted for $> 60\%$ of the total cases. The frequency of imported cases in summer and autumn ($\sim 70\%$ of total cases) was similar in both countries. This study demonstrates that there is a similar pattern of imported dengue cases in Korea and Japan. Therefore, there is a risk of an autochthonous dengue outbreak in Korea, as indicated by the recent outbreak in Japan in 2014.

1. Introduction

Dengue fever (DF) is a mosquito-borne febrile disease caused by dengue virus (DENV), which belongs to the genus *Flavivirus* of the family *Flaviviridae* [1]. Four distinct serotypes of the virus (DENV-1–DENV-4) cause various forms of illness from mild fever to severe dengue [2]. According to the latest World Health Organization report, 50–100 million annual dengue infections have been estimated in >100 countries [3].

The virus is transmitted mainly by *Aedes aegypti* and *Aede albopictus* mosquitoes [2,3]. The *Aedes aegypti* mosquito, the principal vector, usually lives in regions where the winter isotherm is maintained at $\geq 10°C$ [3].

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Table 1. Comparison of the prevalence of dengue infection and geographical origin of infections between Korea and Japan, 2006−2010.

	Korea		Japan	
	No. of cases (%)	95% CI	No. of cases (%)	95% CI
No. of cases	367		589	
Prevalence rate	0.15	0.06−0.24	0.09	0.07−0.11
Region				
Southeast Asia:	303 (82.6)	78.3−86.1	411 (69.8)	65.1−72.5
The Philippines	118 (32.2)	27.6−37.1	83 (14.1)	11.3−16.9
Indonesia	55 (15.0)	11.7−19.0	146 (24.8)	21.3−38.2
Thailand	42 (11.4)	8.6−15.1	64 (10.9)	7.7−14.1
Vietnam	30 (8.2)	5.8−11.5	26 (4.4)	2.7−6.1
Cambodia	27 (7.4)	5.1−10.5	20 (3.4)	1.9−4.8
Laos	12 (3.3)	1.8−5.7	12 (2.0)	0.9−3.1
Malaysia	10 (2.7)	1.4−5.0	24 (4.1)	2.5−5.0
Myanmar	6 (1.6)	0.7−3.6	6 (1.0)	0.2−1.8
Singapore	1 (0.3)	−	6 (1.0)	0.2−1.8
East Timor	2 (0.5)	−	5 (0.8)	−
Others	−		19 (3.2)	1.8−3.6
Southern Asia:	51(13.9)	10.7−17.8	118 (20.0)	17.8−24.4
India	39 (10.6)	7.9−14.2	90 (15.3)	12.4−18.2
Pakistan	−	−	1 (0.2)	−
Bangladesh	6 (1.6)	0.7−3.6	10 (1.7)	0.7−2.7
Maldives	3 (0.8)	0.2−2.5	4 (0.7)	−
Nepal	−	−	2 (0.3)	−
Sri Lanka	2 (0.5)	−	6 (1.0)	0.2−1.8
Others	1 (0.3)	−	5 (0.8)	−
Eastern Asia:	4 (1.1)	0.3−2.9	10 (1.7)	0.7−2.74
China	3 (0.8)	−	−	
Taiwan	1 (0.3)	−	1 (0.2)	−
Others	−	−	9 (1.5)	0.5−2.5
South America	1 (0.3)	−	15 (2.5)	1.3−3.9
Central America	1 (0.3)	−	7 (1.2)	0.3−2.0
Africa	1 (0.3)	−	7 (1.2)	0.3−2.0
Oceania	−	−	14 (2.4)	1.2−3.6
Other countries	6 (1.6)	0.7−3.6	7 (1.2)	0.3−2.0
p	$p < 0.01$		$p < 0.01$	
Total	367 (100)		589 (100)	

The Chi-square test was used to assess whether differences according to each variable are statistically associated. Prevalence rate per 100,000 population. CI = confidence interval.

Because both Korea and Japan are located above this winter isotherm, the *Aedes aegypti* mosquito cannot survive. However, *Aedes albopictus* mosquito, a secondary vector, is abundant in both countries [4,5]. Thus, both countries could be at risk of dengue establishment.

In Korea, no indigenous dengue cases have been confirmed, and all reported cases were diagnosed in travelers returning from endemic or epidemic countries [6−8]. In Korea, DF was legally classified as a notifiable infectious disease in August 2000. DF is a notifiable infectious disease in Japan, designated by the Infectious Disease Control Law in 1999 [9,10]. In Japan, there were DF outbreaks between 1942 and 1945; however, no domestic cases were reported prior to 2014 [9−11] when Japan experienced an unexpected small dengue outbreak in 2014 [12].

In this study, we conducted a comparative observation of the epidemiological characteristics and risk factors of DF between Korea and Japan during 2006 to 2010.

2. Materials and methods

We used raw data of 367 DF cases in Korea between 2006 and 2010, which were obtained from the infectious diseases surveillance yearbook available on the Korea Centers for Disease Control and Prevention website [13]. Data of 589 DF cases in Japan during the same time period were obtained from Annual Surveillance Data and the Infectious Diseases Weekly Report, both available on the Infectious Diseases Surveillance Center (IDSC) website [14,15].

Table 2. Comparison of epidemiological aspects of imported dengue in terms of sex, age, and seasons between Korea and Japan, 2006−2010.

	Korea		Japan	
	No. of cases (%)	95% CI	No. of cases (%)	95% CI
No of cases	367		589	
Sex				
Male	241 (65.7)	60.7−70.3	382 (64.9)	60.9−68.7
Female	126 (34.3)	29.7−39.3	207 (35.1)	31.4−39.1
p	$p < 0.01$		$p < 0.01$	
Age (y)				
< 9	2 (0.5)	0.02−2.10	13 (2.2)	1.3−3.8
10−19	35 (9.5)	6.9−13.0	45 (7.6)	5.7−10.1
20−29	119 (32.4)	27.8−37.4	239 (40.6)	36.7−44.6
30−39	106 (28.9)	24.5−33.7	126 (21.4)	18.3−24.9
40−49	63 (17.2)	13.6−21.4	92 (15.6)	12.9−18.8
50−59	32 (8.7)	6.2−12.16	40 (6.8)	5.0−9.1
> 60	10 (2.7)	1.4−5.0	34 (5.8)	4.1−8.0
p	$p < 0.01$		$p < 0.01$	
Seasonality				
Spring (Mar−May)	42 (11.4)	8.6−15.1	91 (15.9)	13.1−19.1
Summer (Jun−Aug)	119 (32.4)	27.8−37.4	172 (30.0)	26.4−33.8
Autumn (Sep−Nov)	143 (39.0)	34.1−44.0	228 (39.7)	35.8−43.8
Winter (Dec−Feb)	63 (17.2)	13.6−21.4	83 (14.5)	11.8−17.6
p	$p < 0.01$		$p < 0.01$	

The Chi-square test was used to assess whether differences according to each variable are statistically associated. CI = confidence interval.

To better quantify the impact of DF on health in Korea and Japan, we compiled and analyzed the prevalence rate (PR) per 100,000 population and related risk factors such as sex, age, seasonal distribution, and the geographic origin of infection. The regions were defined based on the above data set. Information on length of travel and nationality of patients was not available. The PR was calculated as the number of reported cases divided by the midyear population based on the resident registration, multiplied by 100,000. Statistical analysis was performed using Excel 2007 statistical software (Microsoft Corp., Redmond, WA, USA). The Chi-square test was used to assess whether differences according to each variable are statistically associated. A p value < 0.05 was considered statistically significant.

3. Results

Table 1 shows the PR and travel destination of imported dengue cases in Korea and Japan between 2006 and 2010. The average PR of imported DF was 0.15 per 100,000 population, with 35−125 annual notifications, in Korea and 0.09 per 100,000 population, with 58−245 annual notifications, in Japan. These values may be underestimated because a number of dengue cases are not immediately apparent, and these patients are not likely to see a doctor. Koreans and Japanese tend to travel to developing Asian countries [16,17], where the risk for DF is significantly higher than in other countries. The most frequently suspected region as the origin of infection was Southeast Asia ($p < 0.01$) in both countries. The frequencies of Southern Asia, South America, and Oceania as the origins of infection were much lower in Korean travelers than in Japanese travelers. Therefore, the incidence of imported dengue is influenced by travel destinations. Table 2 shows the comparison of the epidemiological aspects of sex, age, and seasonality. More cases were men than women in both Korea (65.7% vs. 34.3%, $p < 0.01$) and Japan (64.9% vs. 35.1%, $p < 0.01$). The proportion of infections by sex was similar in both countries. The data may represent a difference in activities associated with exposure between men and women.

DF is typically acknowledged as a childhood disease and is an important cause of pediatric hospitalization in Southeast Asia. However, there is evidence of an increasing incidence of DF in older age groups [2,3,18]. The distribution of infection by age group was similar in Korea and Japan, with >60% of the cases occurring in those aged 20−39 years ($p < 0.01$). The incidence was higher between August and October than other seasons in both Korea and Japan ($p < 0.01$). This specific period represents the time when people in both countries are likely to take vacations.

4. Conclusion

In conclusion, this study demonstrates that there is a substantial amount of imported dengue cases in Korea and Japan. There is a risk of an autochthonous outbreak with a higher number of imported dengue cases, as indicated by the recent dengue outbreak in Japan in 2014. To minimize the number of imported dengue cases, timely information on dengue epidemics should be routinely provided to the medical community and individuals who are planning travel abroad.

Conflicts of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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