



Trend and geographic analysis of the prevalence of dengue in Taiwan, 2010–2015



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SUMMARY

Background: Dengue is the most rapidly spreading disease caused by a mosquito-borne virus in the world. The incidence of dengue globally has increased 30-fold in the last 50 years. Understanding the prevalence of dengue and its longitudinal trends can improve prevention and control strategies. This study assessed the trends in prevalence of dengue in Taiwan by population characteristics and geographical region.

Methods: Dengue and population data for the years 2010–2015 were obtained from the public statistics databases of the Taiwan Centers for Disease Control and Department of Statistics, Taiwan Ministry of Interior. Yearly prevalence rates of dengue were calculated by age group, sex, and administrative area within five geographic regions (northern, mid-western, southern, and eastern regions, and outer islands).

Results: The national prevalence rate of dengue decreased gradually from 8 to 4 per 100 000 population between 2010 and 2013, but it increased substantially in 2014 and 2015 to 67 and 187 per 100 000 population, respectively. There was no significant difference in prevalence rate between males and females. People aged 60–69 years had a significantly higher prevalence rate than those in the other age groups during 2010–2014, and people aged over 70 years had the highest rate in 2015 (309 per 100 000 population). The southern region had the highest yearly dengue prevalence rate (the rate decreased from 23 to 9 per 100 000 population between 2010 and 2013, but increased to 220 and 616 per 100 000 population in 2014 and 2015, respectively). Three unexpected outbreaks of dengue were observed during the study period: the first outbreak occurred in Penghu County in 2011 (prevalence rate 101 per 100 000 population), the second in Kaohsiung City in 2014 (prevalence rate 540 per 100 000 population), and the third in Tainan City in 2015 (prevalence rate 1208 per 100 000 population). **Conclusions:** More efforts are still needed to prevent and control dengue in Taiwan. The government should direct resources and interventions to southern Taiwan, which has a tropical climate and a high population density, and should target older people who are more likely to be infected. Strategies are also needed to respond quickly to unexpected incidents to prevent dengue outbreaks.

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1. Introduction

Dengue is an endemic disease with frequently occurring outbreaks in the Southeast Asia, Western Pacific, Latin America, Africa, and Eastern Mediterranean regions.^{1,2} Dengue is transmitted by the bite of *Aedes* mosquitoes infected with the dengue virus

(DENV) and can develop into a potentially lethal condition called severe dengue.³ World Health Organization (WHO) estimates suggest that the incidence of dengue has increased 30-fold globally over the last 50 years, and around 50–100 million infections occur annually worldwide.^{4,5}

Dengue commonly occurs in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas.⁶ DENV can be divided into four serotypes (DENV 1, 2, 3, and 4), each of which confers partial cross-protective immunity to the other serotypes in humans.⁷ According to previous studies in Taiwan, most of the

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severe manifestations of dengue infection occur among older people or patients experiencing a secondary DENV infection that has a different serotype from the previous one;^{1,8,9} infection with type 2 DENV, in particular, has been associated with severe dengue illness such as dengue hemorrhagic fever (DHF).⁷ In Southeast Asia, most cases are asymptomatic; only 24% of infected persons show clinical symptoms.⁸ Severe dengue (DHF) is a leading cause of serious illness and death among children in some countries.¹⁰ Currently there is no specific treatment for dengue, but early detection and access to proper medical care lower fatality rates.^{5,11}

The reported case mortality of dengue varies from country to country. On average, the mortality is 1–5%, but it has been reported to be as high as 73% in Colombia.⁵ For governments, dengue represents a substantial economic burden.^{4,12,13} Some studies have suggested that the annual cost attributable to dengue treatment is about US\$2.1 billion in America and \$950 million in Southeast Asia.^{4,13} The economic burden is likely influenced by the prevalence of dengue and disease severity.

Taiwan faces dengue outbreaks in the summer every year. A previous study in Taiwan found that most dengue patients during the years 2002–2007 were adults, with dengue fever peaking in the 50–54 years age range and severe dengue peaking in the 60–64 years age range.⁸ Another study found that older people were at a high risk of dengue-related mortality in Kaohsiung in Taiwan during the years 2003–2009.⁹

A better understanding of the prevalence of dengue and its recent trends can inform improvements in prevention and control strategies. The aim of this study was to assess the trends in prevalence of dengue in Taiwan by population characteristics (sex and age) and geographical region for the period 2010–2015.

2. Methods

Dengue data reported in the public statistics databases of the Taiwan Centers for Disease Control (CDC) were obtained for the years 2010–2015 (6-year period). The data were monthly numbers of new dengue fever cases (including both outpatient and inpatient settings) by sex and age reported in each administrative division in Taiwan. In addition, yearly population data by region were obtained from the Department of Statistics, Taiwan Ministry of Interior.

Yearly prevalence rates of dengue were calculated by population characteristics (sex and age). The divisions were grouped into five regions: northern, mid-western, southern, and eastern regions, and the outer islands (see Appendix). Divisions were also classified

into urban or rural areas by population density, which was calculated by population number divided by geographic area (km²) for each division. Divisions with a population density higher than 700 people per square kilometer were considered urban areas and those with a density less than 700 people per square kilometer were considered rural areas. Yearly numbers of dengue cases were calculated based on the monthly numbers of new dengue fever cases for each administrative division and geographic region. The prevalence rate was estimated as follows: yearly number of reported dengue fever cases in each region divided by the number of people in the population in the same region.

3. Results

Nationally, the prevalence rate of dengue fever was relatively stable at 8 per 100 000 population in 2010 to 4 per 100 000 population in 2013; however, the rates in 2014 and 2015 were much higher at 67 and 187 per 100 000 population, respectively (Table 1).

The yearly prevalence rates for males and females were similar during the study. People aged 60–69 years generally had the highest yearly prevalence rate, except in 2015 when people aged over 70 years had the highest rate. Children aged 0–9 years had the lowest yearly prevalence rate during the study. There was an approximately 3.6-fold difference in prevalence rate between the age groups in 2015.

Table 2 shows the yearly numbers of cases and population-adjusted prevalence rates of dengue by region and administrative division in Taiwan. Between 2010 and 2014, the prevalence rates in the northern (range 1–2 per 100 000 population), mid-western (1 per 100 000 population), and eastern (range 0–3 per 100 000 population) regions were relatively stable. The rates were slightly higher in 2015, with rates at 4, 4, and 6 per 100 000 population in the northern, mid-western, and eastern regions, respectively. In the northern region, urban areas (Taipei City, New Taipei City, and Taoyuan City) had relatively higher prevalence rates of dengue during 2010–2015 compared with rural areas (e.g., Yilan County, Hsinchu County, and Miaoli County). In 2015, the mean prevalence rate in urban areas within the northern region was 4.35 per 100 000 population, while it was 3.64 in rural areas, reflecting a 1.19-fold difference between them. Similar patterns were seen in the mid-western and eastern regions. Figure 1 shows prevalence rates of dengue by region over time. Figure 2 illustrates the yearly prevalence rates of dengue by administrative division over time.

Table 1
Yearly numbers of cases and population-adjusted prevalence rates of dengue by population characteristics in Taiwan, 2010–2015

	Year											
	2010		2011		2012		2013		2014		2015	
	Case number	Prevalence rate (per 100 000 population)	Case number	Prevalence rate (per 100 000 population)	Case number	Prevalence rate (per 100 000 population)	Case number	Prevalence rate (per 100 000 population)	Case number	Prevalence rate (per 100 000 population)	Case number	Prevalence rate (per 100 000 population)
Sex												
Total	1888	8	1700	7	1477	6	857	4	15 705	67	43 832	187
Male	932	8	855	7	746	6	430	4	7827	67	21 838	186
Female	956	8	845	7	731	6	427	4	7878	67	21 994	187
Age group, years												
Total	1888	8	1700	7	1477	6	857	4	15 705	67	43 832	187
0–9	61	3	59	3	31	2	23	1	585	29	1732	85
10–19	157	5	148	5	125	4	79	3	1572	57	4242	160
20–29	284	8	214	6	217	7	134	4	2044	64	5653	177
30–39	302	8	285	7	233	6	167	4	2450	62	6172	157
40–49	290	8	296	8	228	6	118	3	2433	67	5541	153
50–59	370	11	341	10	320	9	142	4	2924	82	7488	208
60–69	226	13	226	12	184	9	121	6	2398	104	6950	278
>70	198	11	131	7	139	8	73	4	1299	67	6054	309

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