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Economic costs and burden of dengue disease in Cavite Province, Philippines

Custos econômicos e impacto da dengue na Província de Cavite, Filipinas

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ABSTRACT

Aims: To determine the economic costs and the burden of dengue disease in Cavite Province, one of the areas highly inflicted by dengue disease in the Philippines.

Methods: This study used Disability Adjusted Life Years (DALYs) to calculate burden of dengue disease and quantified direct and indirect costs due to hospitalization and ambulatory dengue cases. DALYs were estimated using methods developed by the World Health Organization and the World Bank. We specifically calculated Years of Life Lost from 2009 to 2014 using patient-level data from hospitals and derived Years Lived with Disability from hospital records of dengue specific type (dengue fever/dengue hemorrhagic fever) in Cavite Province.

Results: An annual cost of Philippine Peso (PHP) 99,147,173 which is equivalent to United States Dollar (USD) 2,300,000 was obtained. The average annual cost per dengue case was PHP 32,324 (USD 734). The 21-25 age sub-groups had the highest average annual direct cost which amounted to PHP 243,181 (USD 5,526), followed by the 45-54 age sub-groups which amounted to PHP 201,481 (USD 4,579). From 2009 to 2014, the annual burden of disease was estimated at 178,282 DALYs (equivalent to one DALY lost per 17 persons in Cavite Province).

Conclusions: The estimates of costs and DALYs suggested substantial dengue disease burden and economic costs in Cavite Province, Philippines.

KEY WORDS: dengue; burden of disease; burden of illness; disease costs; disability-adjusted life years; costs and cost analysis; productivity loss; Philippines.

RESUMO

Objetivos: Determinar os custos econômicos e o impacto da dengue na Província de Cavite, uma das áreas altamente infligidas por dengue nas Filipinas.

Métodos: Este estudo utilizou os anos de vida ajustados por incapacidade (Disability Adjusted Life Years - DALYs) para calcular o impacto da dengue e quantificar os custos diretos e indiretos devidos aos casos de dengue atendidos em hospital ou em ambulatório. Os DALYs foram estimados usando métodos desenvolvidos pela Organização Mundial de Saúde e pelo Banco Mundial. Calculamos especificamente os anos de vida perdidos entre 2009-2014, usando dados dos pacientes hospitalizados. Os anos vividos com incapacidade foram derivados de registros hospitalares sobre o tipo específico da dengue (dengue clássica / dengue hemorrágica) na Província de Cavite.

Resultados: Foi identificado um custo anual de 99.147.173 pesos das Filipinas (PHP), equivalentes a 2.300.000 dólares dos Estados Unidos (USD). O custo médio anual por caso de dengue foi 32.324 PHP (734 USD). O subgrupo etário 21-25 anos teve o maior custo direto anual, que atingiu 243.181 PHP (5.526 USD), seguido pelo subgrupo 45-54 anos, que atingiu 201.481 PHP (4.579 USD). De 2009 a 2014, o impacto anual da doença foi estimado em 178,282 DALYs (equivalentes a um DALY pedido por cada 17 pessoas na Província de Cavite).

Conclusões: As estimativas de custos e os DALYs sugerem um alto impacto e substanciais custos econômicos da dengue na Província de Cavite, Filipinas.

DESCRITORES: dengue; efeitos psicossociais da doença; carga da doença; impacto da doença; custos da doença; anos de vida perdidos por incapacidade; custos e análise de custo; perda de produtividade; Filipinas.

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Abbreviations: BOD, burden of disease; CFR, case fatality ratio; DALYs, disability-adjusted life years; DOH, Department of Health; GBD, global burden of disease; ICF, International Classification of Functioning, Disability and Health; YLL, years of life lost; YLD, years lived with disability; PH, Provincial Hospital; SEA, Southeast Asia; WHO,World Health Organization.

INTRODUCTION

Dengue disease, a mosquito-borne viral infection, is estimated to affect more than 30% of the world population in 2055 [1]. Although dengue incidence is generally under-reported in developing countries due to poor surveillance and monitoring systems, current estimates of World Health Organization (WHO) put dengue infections at 50-100 million worldwide every year [2]. In a 2014 WHO report, dengue has not only increasing rapidly in tropical countries in South East Asia and the Pacific, but also has been expanding into non tropical countries in Western Europe, Eastern Europe and the United States [3].

In the Americas, Southeast Asia and the Pacific region, dengue cases almost doubled between 2008 and 2010, from 1.2 million cases to 2.3 million cases [2]. In the Western Pacific and Southeast Asia regions, which includes the Philippines and Laos, there is a noticeable increase in the levels of dengue incidence and a matter of concern in the Philippines, especially because children under nine years old are disproportionately affected and die [2,4,5]. Although dengue surveillance has improved in the Philippines, systematic assessment of dengue would require regional studies tracking demographic changes, as dengue has been correlated with population increase and urbanization [4,6]. So far, epidemiological information on dengue in the Philippines has been for the most part based on cross country national studies in Southeast Asia using multiple published reports with little or no independent regional studies to track demographic information to decision-making [7,8]. All of these have raised concern on data gaps about a disease for which currently no vaccine exists.

Dengue fever is an acute disease clinically characterized by sudden onset of fever that can reach 40 °C and usually lasts for 2-7 days. Other symptoms progressively appear, as muscle and joint pain, sore throat, headache, anorexia, and macular skin rash [9]. Most often the patient becomes lethargic and cannot perform his/her usual tasks. Bed rest is usually required, regardless of whether the patient experiences a self-limiting clinical course, or progressively develops the dengue hemorrhagic fever, the most severe clinical form of the disease [9,10]. Corollary to this, the patient is usually sent to the hospital when the disease has already progressed into a less manageable state, especially when blood platelets drop to a critical level and may lead to hemorrhage. In this case, surveillance and monitoring of high risk areas and age sub-groups in a population may be the key to better decisions by health officials in the management and care of dengue disease.

The best prevention in the absence of vaccine should focus not only on dealing with vector eradication, but there is also a need to increase funding for both surveillance and clinical management. Most of dengue cases require hospitalization which almost always is out of the reach of the poor [2]. Additionally, in developing countries the high incidence of dengue exists in an environment where policy-makers are faced with economic choices requiring clear evidence of net benefits for decision-making [11-13]. Thus, quantifying the economic costs and the burden of disease (BOD) remains a useful tool to provide broad information on dengue disease as well as convince policy-makers on the need to increase resources for management and care and provide control strategies and priorities [14-16].

This study used patient-level data from hospitals in Cavite Province and employed a disability-adjusted life years (DALYs) model to account for years of life lost and years lived with a disability due to disruption of health and preclusion of physical activities. Its overall goals were to quantify the burden of dengue disease, calculate economic costs, and identify age groups and areas associated with dengue cases in Cavite Province from 2009 to 2014. These results may help improve understanding of economic losses arising from premature deaths, including diminished earnings during illness or disability attributable to dengue.

METHODS

Although health evaluations may entail substantial societal costs (i.e., costs accruing to parties other than the patient involved), this study focuses on individual considerations of cost based on loss of work days due to dengue disease.

Area of data collection

BOD and economic costs of dengue were calculated to reflect on years of healthy life lost and to quantify diminished productivity, as well as to

identify the age subgroup and areas most vulnerable to dengue in the Province of Cavite, Philippines. The used data covered 21 out of 23 municipalities and cities in Cavite Province. Cavite Province is an ideal setting to understand public health impact caused by dengue due to rapid population increase and urbanization. It is one of 81 provinces in the Philippines and is located about 34 km south of Manila. It has a population of 3,078,727 [17] and is generally regarded as the fastest growing province. The annual population growth rate of 4.12% is fueled partly by in-migration due to its proximity to Manila and other provinces in the Southern Luzon area. The National Epidemiology Center of Philippine Department of Health (DOH), in 2013, ranked Region IVA, an aggregation of five provinces with an estimated population of 12.61 million [17] (also known as Calabarzon region, that comprises the provinces of Cavite, Laguna, Batangas, Rizal and Quezon), as the second out of 17 regions in terms of number of dengue reported cases [18].

Datasets and variables

The unique datasets used for this study came from consolidated reports of Provincial Hospital (PH) of Cavite from 2009-2014 period. The datasets contained the following variables: age, gender, number of days of hospitalization, municipality or city of dengue patients, type (private or public) and name of the hospital where patients were cared for, outcome (death or survived), hospitalized or ambulatory (outpatient) treatment and type of dengue (DF or DHF).

Under the Law of Reporting Notifiable Diseases Act 3573 [19], private and public hospitals, including all municipal health offices and centers are required to report all infectious diseases to the Provincial Hospital in Cavite as part of DOH Disease Surveillance and Unified Health Management Information System [20,21]. From these datasets, we discovered that daily costs of hospital care were not included. We requested costs of daily care of dengue patients from fairly representative hospitals in Cavite Province and received the data under confidentiality agreement with the concerned hospitals.

These additional datasets from 2009-2014 was used to cross check and complement the consolidated datasets which we received from PH. Specifically, we estimated daily medical costs (which includes doctors' fees, medicines, laboratory tests and room charges) of dengue conservatively by taking the average of the lower bound of the daily cost care reports obtained from selected hospitals. We multiplied daily medical costs of hospital care by the number of days dengue patients stayed in the hospitals to get total hospital bills for different age groups for 2009-2014. Because datasets on daily hospital costs obtained from the representative hospitals ranged from 2009 to 2014, we deflated yearly hospital bills to accout for inflation [22]. To remove these effects, we deflated, i.e., converted the nominal costs into Philippine Peso (PHP) cost. This process involves dividing the nominal costs by Philippine implicit price deflator for GDP (2000=100) which is reported by the Philippine National Statistical Coordination Board.

Determination of costs

In addition to direct medical costs due to dengue disease, we estimated the indirect costs conservatively as well, by accounting for productivity losses using actual number of days stayed in the hospital as proxy for productivity losses. Although Human Capital and Friction costs methods have been used extensively in economic losses attributable to diseases, we avoided using both specifically methods because the assumptions that underlie them do not apply to this study. Both methods tend to capture costs relevant to the patient and society [23-25]. However, in this study, we focused solely on private considerations but not on society's perspective. We calculated costs following studies that modeled valuae of productivity loss as a function of labor days due to illness multiplied by the daily per capita wage rate (2009-2014) adjusted for inflation rate [23,26-29] to account for possible influence of inflation.

We used the Cavite Province Average Minimum Wage Rate in non-agriculture and agricultural sectors [30] to calculate productivity lost. In calculating for productivity loss, we assumed that patients who were less than 21 years old and more than 65 years old were not part of the labor force. We took a very practical perspective in our assumptions even if the working age in the Philippines is 16 years and compulsory mandated retirement in government is 65 years. We did not factor in employment rate for patients within the working age (that is, 16-20 years), cost of lost school days and cost of home care after hospital discharge.

Additionally, we calculated the value of productivity lost by using actual number of days in the hospital reported in PH which appears to be in line with and within lower bound estimates used for both hospitalized and non-hospitalized dengue cases in previous studies [31,32]. We calculated DALYs for Cavite Province by employing the approach used in

BOD studies [33] and reflected DALYs as a summation of years of life lost (YLL) due to premature mortality from dengue and years lived with disability (YLD) due to dengue disease.

Calculation of years of life lost

We calculated YLL through death reports from the consolidated PH reports from 2009-2014. We used the ideas developed in Global Burden of Disease (GBD) study to determine the remaining years of life at the age of death [33,34]. We used life expectancy calculators that allowed for discrete count of ages from 0-100 based on life expectancy at birth of 75.4 for males and 80.4 for females. The life expectancy at birth which we used was closer to both the Philippines and WHO's global life expectancy for 2012 [35]. We calculated age remaining at death using life expectancy calculators for each age from 0-100. Thus, there was no need for interpolating age that fall within an interval. We incorporated discounting, but not weights. Although Murray and Lopez work modeled weighing widely incorporated into DALYs studies based on "societal preference to value a year lived by young adults more highly than those of infants and older people" [34]; some scholars question social preference on ethical grounds. Even if we believe that such social preference is possible, there is no reason to deny that social preferences do not or should not change over time.

DALYs has been used extensively in health studies to quantify premature life lost due to death and disability suffered in living with a disease. Previous GBD studies used discounting and age-weighting in calculating DALYs. Discounting and age-weighting has always been justified depending on the perspective used [36].The newly revised 2010 GBD calculation of DALYs favors simpler formula dropping age-weighting and discounting, but, retains disability weights [37]. A recent critic on disability weights argues that it does not conform to the concepts and measures of disability as defined by the International Classification of Functioning, Disability and Health (ICF) [38]. Despite the possibility of differing DALYs estimates due to methods used, DALYs has remained a useful tool in health interventions [39,40]. Our methodology for calculating DALYs used both elements of the revised DALYs and the older GDB studies. We retained discounting from the earlier GDB studies and the disability weights of the newly revised GBD approach. In retaining discounting in our methodology, we followed cost-effectiveness approach and assumed that individuals tend to prefer healthy life now than postpone it in the future. Discounting therefore allows for future health to be expressed in terms of present value [41]. Exhaustive discussions on the merits of different approaches commonly used in calculating DALYs has been done elsewhere [36,40]. Our perspective in this paper is to use DALYs as a conservative measurement tool to understand local BOD for health interventions; and to determine whether our DALYs conform to GBD trends – i.e., BOD shifting away from premature death prevalent in the 1990s to YLD.

We express YLL equation as follows [29]:

$$YLL = \frac{N}{r}\left(1 - e^{-rL}\right) \quad (1)$$

where:
N = number of deaths
L = standard life expectancy at age of death (years)
r = discount rate (3% i.e., 0.03)

We calculated gender and age specific YLLs. The calculated YLLs were summed across age-groups and gender for 2009-2014.

Calculation of years lived with disability

We calculated YLDs using data from the consolidated PH reports for 2009-2014. The data contained type of dengue, thus, allowed specific disability weights to be used [28]. We calculated gender and age specific YLDs and summed across age-groups and gender for 2009-2014.

We express YLDs following standard equation as follows [29]:

$$YLD = \frac{I\,x\,DW\,x\,L\left(I - e^{-rL}\right)}{r} \quad (2)$$

where:
I = number of incident cases
DW = Disability Weight (DF=0.197, DHF=0.545) [28]
L = duration of disability (years)
r = discount rate (3% i.e., 0.03)

We calculated gender and age specific YLDs and summed across age-groups and gender for 2009-2014.

Ethics

This study was approved by the Ethics Review Committee from De La Salle University-Dasmariñas, Dasmariñas, Cavite Province, Philippines, according the DLSUD-ERC 4(B)2015-Approval.

RESULTS

Economic costs and burden of disease

The number of dengue cases was dominated by young patients, between 0-15 years old, while the least were the elderly group, ages 65 and above (**Table 1**) .

The direct cost of dengue patients was determined based on the hospital expenses by age sub-groups for 2009-2014. We obtained an annual cost of PHP 99,147,173 which is equivalent to United States Dollar (USD) 2,300,000 (PHP 44=USD 1) [42] or total direct cost for the six-year period amounting to PHP 594,883,039 (USD 13,500,000) (**Table 2**). In terms of average annual cost per dengue case, we obtained PHP 32,324 (USD 734). The 21-25 age sub-groups had the highest average annual direct cost which amounted to PHP 243,181 (USD 5,526), followed by the 45-54 age sub-groups which amounted to PHP 201,481 (USD 4,579).

The indirect cost or cost of productivity loss due to ill-health caused by dengue by age sub-groups for 2009-2014 is shown in **Table 3**. Productivity cost loss was computed using lost wages and restricted to the age group 21-64, which is the age group most likely to be active in the Philippine labor force.

Table 1. Direct costs of hospitalization of dengue patients for 2009-2014 in the Province of Cavite, Philippines.

Age (years)	Number of cases	Number of days in the hospital	Hospital bill (PHP)	Average hospital bill (PHP)
0-4	2,489	9,267	70,855,825	190,264
5-15	9,604	34,989	265,314,940	192,919
16-20	3,360	11,970	91,816,663	186,456
21-25	1,865	6,817	76,391,029	243,181
26-34	1,892	6,895	53,432,046	190,447
35-44	709	2,606	20,126,993	193,546
45-54	317	1,140	9,042,335	201,481
55-64	161	543	4,106,453	177,305
65-74	63	233	1,794,868	195,287
75-84	30	106	822,326	183,858
≥85	65	157	1,179,556	178,673
Total	20,555	74,723	594,883,039	2,133,421

PHP, Philippine Peso.

Table 2. Direct cost of hospitalization of dengue patients for 2009-2014 in the Province of Cavite, Philippines, in Philippine Peso and United States Dollar

Direct Cost	PHP	USD
Average annual cost per patient	32,324	734,650
Annual cost	99,147,173	2,300,000
Total for 2009-2014	594,883,039	13,500,000

PHP, Philippine Peso; USD, United States Dollar.
USD 1.00=PHP 44.00.

Table 3. Indirect costs of hospitalization of dengue patients for 2009-2014 in the Province of Cavite, Philippines.

Age (years)	Number of cases	Number of days in the hospital	Productivity cost loss (PHP)	Average productivity loss (PHP)
0-4	76	272	0	0
5-15	237	956	0	0
16-20	105	379	0	0
21-25	70	266	1,393,341	19,904
26-34	83	312	1,418,606	17,091
35-44	29	107	534,364	18,426
45-54	25	106	240,070	9,602
55-64	6	17	109,022	18,170
65-74	3	12	0	0
75-84	2	6	0	0
≥85	1	3	0	0
Total	636	2,433	3,695,403	83,193

PHP, Philippine Peso.

The 21-25 age sub-groups had the highest average annual indirect cost which amounted to PHP 19,904 (USD 452) while the 45-54 age sub-groups had the least cost in terms of productivity loss which amounted to PHP 9,602 (USD 218) (**Table 4**). We obtained an annual cost which amounted to PHP 615,900 (USD 13,997) or total indirect cost for the six-year period which amounted to PHP 3,695,403 (USD 83,986). In terms of average annual cost of productivity per dengue case, we obtained PHP 2,773 (USD 63).

Years lived with disability

The BOD is presented by gender in **Table 5**. More than 99% of dengue BOD was attributable to dengue illness, represented by YLDs, and only less than 1% was attributable to mortality, represented by YLLs. These findings are in line with current trends which indicate that the proportion of disability-adjusted life years attributable to YLDs has increased globally [43]. In terms of overall BOD, males accounted for about 60% and female for 40%. Overall, the data show that 178,282 years of healthy life were lost due to premature death (YLLs) and due to illness (YLDs) from dengue in Cavite Province annually (2009-2014). This is equivalent to one DALY lost per 17 persons in that province.

Disability-adjusted life years

In terms of age groups, DALYs were highest at 426 per 1,000 for females aged 45-54 years, followed by 387 per 1,000 for males aged 1-4 years and a close third were females aged less than one year (**Table 6**).

Table 4. Productivity cost loss estimates per patient due to dengue for 2009-2014 in te Province of Cavite, Philippines

Productivity cost loss*	PHP	USD
Average annual productivity cost loss per patient	2,773.10	63.03
Annual total productivity cost loss	615,900.50	13,997.74
Total productivity cost loss for 2009-2014	3,695,403.00	83,986.43

* Productivity Cost Loss = number of days in hospital x minimum wage (adjusted for inflation).
PHP, Philippine Peso; USD, United States Dollar.
USD 1.00=PHP 44.00.

Table 5. Burden of dengue disease by gender in Cavite Province, Philippines, 2009-2014

	Years of life lost	Years lived with disability	Disability adjusted life years	Average disability adjusted life years
Male	1,337	642,803	644,140	107,357
Female	1,402	424,149	425,551	70,925
Total	2,739	1,066,952	1,069,691	178,282

Table 6. Average disability-adjusted life years per 1,000 population in Cavite Province, Philippines, 2009-2014

Age interval (years)	Male		Female	
	Dengue cases per 1,000	DALYs per 1,000	Dengue cases per 1,000	DALYs per 1,000
<1	8.500	210.313	7.601	385.765
1-4	6.763	387.601	6.771	353.053
5-14	12.522	273.466	12.302	319.127
15-24	10.591	81.331	7.568	62.399
25-34	4.244	190.083	3.174	124.955
35-44	1.736	65.060	1.343	80.357
45-54	1.014	0.025	1.025	426.750
55-64	1.024	209.576	0.866	219.291
65-74	0.795	0.039	0.871	0.030
75-84	1.275	0.025	0.752	0.024
≥85	1.044	0.004	1.479	0.048

DALYs, disability-adjusted life years.

DISCUSSION

During the last decade and encouraged by WHO, a growing literature on health economics [12,27,28, 44-48] has emerged investigating life lost due to premature death and life with disability associated with debilitating diseases including dengue [5,7,49]. There has been reports linking dengue cases with specific age sub-groups and areas in the Philippines, but there has been little or no BOD studies linking dengue infection with age sub-groups or areas both on the regional and national levels in the Philippines [4].

From 2009 to 2014, annual BOD was estimated at 178,282 DALYs (about one DALY is lost per 17 persons in Cavite Province). This study indicates that dengue disease imposes substantial economic costs and BOD in this province. We assessed that annual costs estimates per dengue case in Cavite Province for 2009-2014 were lower than the costs in some Southeast Asia (SEA) countries' average from 2001-2010 [5]: Singapore (USD 4,276), Brunei (USD 3,290), Malaysia (USD 1,285); and higher than in some SEA countries: Thailand (USD 793), Indonesia (USD 376), Philippines (USD 275), Bhutan (USD 269), Laos (USD 138), Vietnam (USD 107), and East Timor (USD 85). The present estimates for annual per dengue case costs in Cavite Province are substantially higher than Can Tho Province in Vietnam (USD 167), which used 2006-2007 questionnaires administered to patients six to nine months after recovery from dengue [49].

The present study estimates on average indicate that more than 99% of economic costs of dengue were accounted for by direct costs. The substantially lower productivity loss (indirect cost) may be explained by the use of minimum wage, which may have underestimated lost wages of patients whose wages were above minimum wage [47] and the conservative assumptions that duration of sickness is equal to number of days in the hospital. The costs of lost school days and cost of home care after hospital discharge were not included. Additionally, we did not estimate indirect costs for patients who were less than 21 years old and above 65 years old. These lower limits were used to avoid unnecessarily inflating the costs. On the other hand, the high direct costs may be related to high hospitalization costs, as 93% of dengue reported cases from 2009 to 2014 were hospitalized, with only 7% reported as ambulatory (out-patient) cases. The 18,770 reported dengue cases translate into an average case fatality ratio (CFR) of 0.01% for 2009-2014. This CFR is much lower than WHOs average (CFR=0.5%) for the Philippines in 2011 [24]. However, our estimate is consistent with SEAs average (CFR=0.01%) for 2001 to 2010 [7].

This study found that the largest number of dengue cases per 1,000 for both male and female occurred in children and adolescents aged 5-14 years, followed by the 15-24 age sub-group with the 1-4 age sub-group at a distant third for both male and female. While both genders show almost the same number of cases per 1,000, there were interesting variations in terms of dengue cases. For example, the female population in the 15-24 age sub-groups was more numerous than the male (female: 297,688, versus male: 285,705), and the dengue cases rate for male was 10.6 per 1,000 compared to female at 7.6 per 1,000. This difference tends to support arguments that dengue disease is gender related in Asia. The dengue cases represent a sharp increase when compared to 28 per 100,000 in the Philippines in 2007 [50]. Although more studies are needed to explain gender differences in dengue reported cases, this could be attributed to the difference in the nature of work of male and female, as the former tends to be more exposed to outdoor work than the latter. Such work trend makes males more exposed to mosquito-borne diseases than females [51].

Differences in dengue cases have always been attributed to gender-related differences between male and female in SEA [52]. In the Philippines, Singapore, Malaysia, Sri Lanka and Cambodia evidence suggest that male dengue cases tend to exceed female cases [5]. However, evidence in South American countries does not clearly show such consistency as male and female dengue cases tend to be equally matched [53].

There are also indications that the severity of dengue cases in SEA, including the Philippines, is related to age. For example, dengue reports in the Philippines show more cases in age sub-groups 1-10 and 11-20, while CFR were highest in children aged 0-10 years [16,38]. This conforms to the weaker immune system of younger patients whose ability to naturally fight against dengue virus is not yet fully developed. Therefore, they are susceptible to a transient increase in vascular permeability resulting in plasma leakage, with high fever, bleeding, thrombocytopenia and haemoconcentration, which can lead to dengue shock syndrome [54,55].

While the clinical manifestations of dengue fever vary among patients, age has been noted as a factor associated with differing signs and symptoms of the disease [56,57]. Dengue fever, the mild form, is more common in adults while dengue hemorrhagic fever, the more severe form, is observed more frequently in children below 15 years of age [40,41,53]. Thus,

understanding age and gender related relationship with dengue infections could help target and prioritize the allocation of resources for dengue management and care.

The average BOD per year represents about one DALY for every 17 persons in Cavite Province, i. e., one year of full healthy life is lost per 17 persons in the whole province population. We found that DALYs per 1,000 for children less 14 years were substantially higher on average than other age sub-groups, except females aged 45-54 years. This may be partly explained by the disproportional premature death in children less than 14 years in the Philippines [4,5,58]. The DALYs for females aged 45-54 years was substantially higher than all other age sub-groups and may be explained by ill-health and disability due to dengue disease as there was no reported premature death in the 45-54 years age sub-groups. The symptoms associated with dengue fever most often leave the patient physically weak. Afflicted individuals cannot perform their daily routine and tasks and are advised for bed rest even in cases of uncomplicated disease [10,52,58]. Those who develop dengue hemorrhagic fever, especially when the platelet count drops and hemorrhage begin to manifest, require hospitalization for strict monitoring and management [15,53].

The estimates of this study were higher than DALYs estimates of 372 per million for 12 SEA countries from 2001-2010 [7]. The variations is a matter for concern as the SEA data represented 10-year averages across 12 countries, while our estimates were based on hospital reports from Cavite Province in the Philippines.

We have used conservative assumptions in estimating economic costs and DALYs associated with dengue disease due to premature death and disability arising from dengue disease. There are obvious limitations due to assumptions introduced in this study, especially the use of minimum wage, working wage of 21-65 years, zero cost of home care after hospitalization and number of days in the hospital as proxy for productivity loss. However, these assumptions did not result in the upward estimate of costs. Instead has helped to keep the estimated costs of dengue reasonable. Our estimates of costs and DALYs suggest substantial BOD for dengue.

In conclusion, the present estimates of costs and DALYs suggest substantial dengue disease burden in Cavite Province, making dengue as one of the major infectious diseases afflicting the population of the province, comparable to tuberculosis, which has an estimated 500,000 DALYs loss annually and a mean cost per DALY as high as USD 242 [59,60]. While there has been reports linking dengue cases with specific age sub-groups and areas in the Philippines, there has been no BOD studies on dengue infections at the regional and national levels in the Philippines. Thus, the present study update further enhances this need, considering that the Philipppines is among the countries with high rates of dengue infection.

NOTES

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Conflicts of interest disclosure

The authors declare no potential conflicts of interest relevant to the content of this study.

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