ASSESSMENT OF DENGUE HEMORRHAGIC FEVER IN MYANMAR

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Abstract. This study assesses the burden of dengue hemorrhagic fever (DHF) and effectiveness of an intervention package in Myanmar. Disability adjusted life years (DALYs) lost for fatal and non-fatal DHF cases and DALYs averted due to intervention for DHF from 1970-1997 were estimated. The data are based on reported cases and deaths from DHF extracted from annual reports of the Myanmar vector borne disease control program. Sensitivity analyses were performed for robustness of conclusions. DALYs lost from both fatal and non-fatal DHF cases in Myanmar were estimated as 83.83 DALYs per year per million population (range = 83.33-86.32) for the period 1970-1997. DALYs averted from DHF due to intervention were estimated as 134 DALYs per year per million population (range = 47-159). The burden of DHF in Myanmar for the selected year 1990 was 91.3 DALYs per year per million population (range = 90.1-96.5). A comparison was made with China, India and other Asian countries based on information provided by a World Bank study.

INTRODUCTION

Dengue fever and dengue hemorrhagic fever (DHF) present serious public health problems in Southeast Asia (Poovaneswari and Lam, 1992), and are a major cause of pediatric morbidity and mortality in both epidemic and endemic forms (Hlaing Myat Thu *et al*, 1998) in Myanmar. Since the first outbreak of DHF in 1970 at Yangon, the capital city, the disease has spread and now become endemic in twelve out of fourteen states/ divisions in Myanmar (Anonymous, 1999). To reduce morbidity and mortality of DHF in Myanmar (Ministry of Health, Myanmar, 1996), an intervention package consisting of improved case management, prevention by vector control and community awareness activities is being implemented within the limit of resources. Though DHF has been recognized as a notifiable disease in Myanmar and intervention is taking place, studies on measurement of the magnitude of the DHF problem and the health impact of intervention is still lacking. In regard to provision of health services to meet all the possible needs of the population, the burden caused by a particular disease (Bobaddilla *et al*, 1994) is an important criterion among others. The burden of any particular disease or injury can be determined by a composite indicator of disability-adjusted life years (DALYs), which is a measure designed to quantify the amount of ill health (Barker and Green, 1996). A World Bank study has evaluated the global burden of more than 200 diseases or injuries including DHF (Murray and Lopez, 1996a). However, country-specific data are essential for national health planning.

The objective of this study is to assess both the burden of disease and the effectiveness of intervention package for DHF in Myanmar so as to offer information to decision makers for a better planning of DHF control.

METHODS

This study estimates DALYs from fatal and non-fatal DHF in Myanmar. The period was covered from 1970 to 1997 depending upon the availability of data.

Data sources

DHF cases and deaths have been extracted from annual reports of the Myanmar vector borne diseases control (VBDC) program, which is responsible for nation wide prevention and control of DHF. An estimation of the length of illness due to DHF was derived from published data with assumptions on clinical grounds. The duration of viremia varied from 2 to 12 days with a median duration of 4 days for all cases and 3.5 days for fatal cases (Gubler *et al*, 1981). The average of the total sick days due to DHF was estimated as 7.9 days (Sornmani *et al*,1995). However, full recovery from DHF takes a considerable time beyond the duration of illness. It is assumed as 20 days with a range of 10 to 30 days. Duration of time lost due to premature death from DHF was calculated as standard expected years of life lost (Barker and Green, 1996). Average age of death from DHF in Myanmar is 10 years (Anonymous, 1999). The disability weight for premature death is 1.0 for all diseases. For non-fatal DHF cases, disability weight was assigned from class 2, valued at 0.22. A range of 0.1 to 0.6 was considered for sensitivity analysis. The description of six classes of disability weight for non-fatal health outcomes have been provided elsewhere (Murray, 1994). Population data of Myanmar was taken from published information (Immigration and Manpower, Myanmar, 1997; International Monetary Fund, 1999).

DALYs averted due to an intervention package for DHF in Myanmar were derived from deaths averted. This is the difference between actual and predicted fatal cases. At present, the case fatality (CFR) of DHF in Myanmar is around 3% (Anonymous, 1999). The predicted fatal cases are derived from CFR where there is no intervention. The CFR with absence of intervention was the CFR of the earlier years of the DHF in Myanmar, in which interventions were not yet well established: this was 9.0% with a range of 5.5% to 10% (Anonymous, 1999). The assumption made here is that CFR over time would be constant without intervention for DHF.

For simplicity, five steps were introduced to estimate DALYs lost from DHF cases, and DALYs averted due to an intervention package for DHF in Myanmar. In this study, two adjustments, discount rate and age weighting, were considered. Future years of healthy life years lost were discounted (Barker and Green, 1996) by 3% to be consistent with long-term yields on investments (Murray, 1994). Non-uniform age weighting was applied. Table 1 provides the steps used in this analysis.

Table 1

Step 1: Discounted cases and death from DHF for the period 1970-1997 were estimated.

Nk = Discounted non-fatal cases for the period 1970-1997.
Nf = Discounted fatal cases for the period 1970-1997.

Step 2: DALYs were estimated for non-fatal DHF cases from four factors: the length of illness, the age weight factor, disability weight for a non-fatal case and number of non-fatal cases (discounted). The formula for this step is:

Dn = [(L/365)* A * Wn * Nk)]
A = $Cx \exp^{(-\beta x)}$ (Murry and Lopez, 1996a).

Where
Dn = DALYs from non-fatal DHF cases from 1970-1997.
L = Length of illness in days.
A = Age weight factor.
Wn = Disability weight for a non-fatal case of DHF.
Nk = Total number of discounted non-fatal DHF cases for the period of study.
x = Age at deaths (*ie*, 10 years in this study).
β = 0.04 (Murry and Lopez, 1996a).
C = 0. 1658 (Murry and Lopez, 1996a).
365 = Total days per year.

Step 3: DALYs lost from fatal DHF cases for the period 1970-1997 were estimated as the product of two factors: DALYs lost due to premature deaths at age 10 and number of fatal cases for the study period. DALYs lost due to premature deaths at age 10 were directly extracted from the provided data (World Bank, 1993; Murray, 1994). The formula for this step is:

Df = (Dd * Nf)

where
Df = DALYs lost from fatal DHF cases for the period 1970-1997.
Dd = DALYs lost due to premature death at age 10 per case (= 36.78, the midpoint of female and male).
Nf = Total number of discounted fatal DHF cases for the period 1970-1997.

Step 4: DALYs were summed up from fatal and non-fatal cases to get total DALYs lost from DHF for the period 1970-1997. This sum was divided by the total number of years observed in this study and then by average annual population. The formula for this step is:

Db = (Dn + Df)
D = (Db/n/P)

where
D = DALYs for both fatal and non-fatal DHF cases per year per million population.
Db = Total DALYs for non-fatal and fatal DHF cases from 1970-1997.
n = Number of years.
P = Annual average population in million.

Step 5: DALYs averted due to intervention for DHF in Myanmar were estimated as the product of two factors: disability weight for a fatal case and deaths averted in Myanmar for the years 1970-1997. The latter is subtracting of the actual fatal cases from the predicted fatal cases from DHF. The formula for this step is:

Dg = [(Np-Nf)* Ds)]

where
Dg = Total DALYs averted for the year 1970-1997.
Ds = DALYs saved from prevention of death at age 10 due to intervention (=Dd).
Np = Predicted fatal cases (discounted) for the year 1970-1997.
Nf = Actual fatal cases (discounted) from DHF for the year 1970-1997.

Sensitivity analysis

Since plausible assumptions are made, the robustness of results must be checked with sensitive parameters. For DALYs lost from DHF, bivariate sensitivity analysis was performed using a range of disability weights and lengths of illness. With regard to the effectiveness of intervention, univariate sensitivity analysis was introduced with a range of CFR with absence of intervention.

Data analysis

Data analysis was performed with the proposed step-wise formulas using the Excel spreadsheet.

RESULTS

Table 2 demonstrates cases and deaths from DHF in Myanmar for the period 1970-1997. The highest number of discounted fatal and non-fatal cases were observed in 1994, which was an epidemic year of DHF in Myanmar. Table 3 displays parameters used in this study. Table 4 describes the burden of DHF for fatal and non-fatal cases in Myanmar. For the period 1970-1997, the burden of DHF in Myanmar was 83.8 (83.3.- 86.4) DALYs per year per million population. Table 5 declares the country comparison for the selected year 1990.

Table 2
Non-fatal and fatal cases from dengue hemorrhagic fever in Myanmar (1970-1997).

Year	Cases	Discounted case	Deaths	Discounted fatal cases	Discounted non-fatal cases	Discounting factor[a]	Predicted fatal cases[b]	Deaths averted due to intervention
1970	1,654	744	91	41	703	0.45	67	26
1971	391	181	34	16	166	0.464	16	1
1972	1,013	484	32	15	469	0.478	44	28
1973	349	172	15	7	164	0.492	15	8
1974	2,477	1,256	159	81	1,175	0.507	113	32
1975	3,750	1,958	364	190	1,767	0.522	176	-14
1976	3,153	1,696	99	53	1,643	0.538	153	99
1977	5,364	2,972	236	131	2,841	0.554	267	137
1978	2,029	1,157	92	52	1,104	0.57	104	52
1979	4,695	2,756	159	93	2,663	0.587	248	155
1980	6,772	4,097	282	171	3,926	0.605	369	198
1981	1,524	949	96	60	890	0.62	85	26
1982	1,706	1,095	49	31	1,064	0.64	99	67
1983	2,856	1,888	83	55	1,833	0.66	170	115
1984	2,323	1,582	39	27	1,555	0.68	142	116
1985	2,666	1,869	134	94	1,775	0.7	168	74
1986	2,092	1,510	111	80	1,430	0.72	136	56
1987	7,424	5,523	233	173	5,350	0.74	497	324
1988	1,178	902	64	49	853	0.77	81	32
1989	1,196	944	62	49	895	0.79	85	36
1990	6,318	5,137	102	83	5,054	0.81	462	379
1991	6,772	5,668	282	236	5,432	0.84	510	274
1992	1,685	1,454	37	32	1,422	0.86	131	99
1993	2,279	2,024	67	59	1,964	0.89	182	123
1994	13,085	11,937	477	436	11,536	0.92	1,078	641
1995	2,477	2,336	53	50	2,286	0.94	210	160
1996	1,854	1,800	18	17	1,783	0.97	162	145
1997	4,005	4,005	82	82	3,923	1.0	360	278
Sum	93,087	68,132	3,552	2,465	65,667	NA	6,132	3,667

[a]The discounting factor in each year t is, [1/ (1+r)], where r = discount rate (3%).
[b]Base case fatality ratio without intervention = 9%; NA = Not applicable.

Table 3
The parameters and their values.

No.	Parameters	Symbol	Value	Source
1	Age weight factor	A	1.11	Derived from the formula[a] (Murray and Lopez, 1996a)
2	Disability weight for a non-fatal case of DHF	Wn	0.22[b] (0.1-0.6)[c]	Assumption
3	DALY lost by premature death at age 10	Dd	36.78	(World Bank, 1993; Murray, 1994)
4	Length of illness in days up to fully recovery	L	20 (10-30)	Assumption with clinical ground
5	Discounted fatal cases from 1970-1997 (actual)	Nf	2,465	Derived (see Table 2)
6	Discounted non-fatal cases from1970-1997	Nk	65,667	Derived (see Table 2)
7	Number of years observed	n	28	From 1970 to 1997
8	Average annual population (million) in Myanmar from 1970-1997	P	39.0	Derived from published information
9	Predicted number of discounted fatal cases from 1970-1997	Np	6,132	Derived (based on Anonymous, 1999)
10	CFR[d] in percentage with absence of intervention	CFR	9.0 (5.5-10.0)	Anonymous, 1999

Parenthesis indicates a range for sensitivity analysis; [a]The formula applied is $Cx \exp^{(-\beta x)}$, where C = 0.1658, β = 0.04, x = 10; [b]Class 2 [Table 3 of Murray (1994)]; [c]Classes 1 and 4 [(Table 3 of Murray (1994)]; [d]CFR denotes case fatality ratio.

Table 4
DALYs[a] for fatal and non-fatal cases of DHF[b] in Myanmar (1970-1997).

Description	Fatal	Non-fatal	Sum of fatal and non-fatal
Number of DHF cases	2,465	65,667	68,132
Total DALYs lost	90,663	878.68 (329.5-3,594.59)	91,542 (90,992-94,257)
Yearly DALY[c]	3,237.96	31.39 (11.77-128.38)	3,269 (3,250-3,366)
DALYs per year per million populations[d]	83.02	0.8 (0.3-3.29)	83.83[e] (83.33-86.32)

Parenthesis indicates the results of bivariate sensitivity analysis with a range of disability weights for a non-fatal case and length of illness; [a]Number of years observed = 28; [b]Estimated annual population (1970-1997) in Myanmar = 39 million; [c]DALY denotes disability adjusted life year; [d]DHF denotes dengue hemorrhagic fever; [e]Round figure.

Table 5
Comparison of DALYs per year per million population for the selected year 1990.

Description	Population in million	Total DALYs for the year 1990	DALYs per year per Million population	Source
Myanmar	41.81[a]	3,821 (3,767-4,036)	91.3 (90.1-96.5)	Author's estimation
China	1,134	29,000	26	(Murray and Lopez, 1996a)
India	850	444,000	522	(Murray and Lopez, 1996a)
Other Asia and Islands	683	255,000	373	(Murray and Lopez, 1996a)
World	5,267	750,000	142	(Murray and Lopez, 1996a)

Parenthesis indicates the results of sensitivity analysis.
[a]International Monetary Fund, 1999.

In 1990, DALYs lost from DHF in Myanmar were 91.3 (90.1-96.5) DALYs per year per million population. DALYs lost from DHF in Myanmar were greater than for China and less than for India and the average of "other Asia and islands". DALYs averted due to intervention are 4,817 (1,684-5,711) for the period 1970-1997. It is noted that 134 (47-159) DALYs per year per million population are saved from an intervention package for prevention and control of DHF in Myanmar.

DISCUSSION

Dengue virus transmission is enhanced by dense human population (Hlaing Myat Thu *et al*, 1998). The relatively less crowded country of Myanmar has a higher burden compared to China is not without implications. Current prevention and control activities of DHF in Myanmar should be reassessed. The comparatively lower burden of DHF than that of India also suggests sharing of experiences with border countries. Consideration of the synergistic strategy for control of DHF among border countries is desirable since there is no geographical boundary for microbes.

Since major victims of DHF in Myanmar are school going age (Anonymous, 1999), learning capacity is affected as a result of school absenteeism along with post-infection weakness. Due to missed workdays of the main caretaker for six days per patient (Sornmani *et al*, 1995), the opportunity costs were taken into account. Though empirical data on these costs are still lacking, they can be explored. The annual loss of 3,269 future life-years due to premature mortality and disability during the period 1970-1997 has a significant impact on national development through loss of potential learning and earning capacities. The intangible costs related to anxiety of the affected community have to be compounded. The annual minimum gain of 1,684 future life-years is evidence pointing out that intervention seems worthwhile for prevention and control of DHF in Myanmar.

The information provided from this study is by no means exaggerated since underestimation of reported cases (Anonymous, 1999) are not corrected. The existing limitations of cost data do not allow this study to be extended to cost-effectiveness analysis at this juncture. However, this study reflects the situation concerning DHF in Myanmar and provides an answer of "where we are now" for decision-makers. It aids in setting health research priorities for DHF. The framework of this paper permits application to other countries and regions. The health impact measured as DALYs could be useful for further cost-effectiveness analysis. It also provides a methodological framework, which can be applied to assess the burden of disease, and the health impact of interventions for other communicable diseases in Myanmar aiming for reassessment of the priority level of different diseases.

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