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Impact of Environmental changes on Infectious Diseases in Myanmar

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Abstract

Like other countries in the world, Myanmar has been facing with health hazards due to environmental factors. Climate changes have great impact on infectious diseases such as vector-borne, water and food borne diseases and also for neglected tropical diseases such as soil-transmitted helminthiasis (STH).The studies pointed out that treatment by chemotherapy alone is not sufficient to control these infections. Environmental sanitation, effective vector control programme, installation of safe water supply, sanitary control of sewage disposal, health education for personal hygienic practices are essential for control of these infection not only by Ministry of Health alone but also by others sectors to raise the health status of Myanmar population.

Key words: Myanmar, climate change, infectious diseases

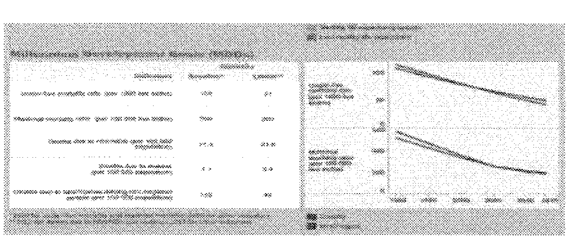
The Republic of the union of Myanmar, formerly known as Burma, is located in Southeast Asia. Myanmar ,with an area of 676,578 km^2,is bordered in north and northeast by China, in east by Laos and Thailand, in south by the Andaman Sea and the Bay of Bengal and in west by Bangladesh and India. Myanmar enjoys a tropical climate with three distinct seasons, summer, rainy and cold season. However, climatic conditions differ widely from place to place due to widely different topographical situations. Myanmar has a population of 51.4 million people (2014 census). The census results show that the population density in Myanmar is76 persons per square kilometer.

About 30 percent of population resides in urban areas (Health in Myanmar, 2014). According to the Department of Meteorology and Hydrology, Myanmar's climate is changing, with some observable trends over the last six decades. These include an increase in mean temperature, an increase in overall rainfall in most areas with a declining trend in some areas, late onset and early termination of the south-west monsoon. Overall there has been an increase in extreme weather events and a rise in sea level. Climate change represents one major challenge as illustrated by a recent study that placed Myanmar in second place globally from extreme weather events in the period 1991-2010 (Global/Myanmar climate change alliance, 2012). On May 1, 2008, Tropical Cyclone Nargis, the category four cyclone led to the deaths of over 138,000 people and destroyed lands along Myanmar's coastline and Ayeyarwady delta, making it among the 10 most destructive cyclones in recorded history. Coastal lands were flooded, and tidal surges inundated low lying areas including the nation's most populous city, Yangon. Recent flooding in Myanmar, due to heavy seasonal rains augmented by Cyclone Komen, have caused floods and landslides in several parts of the country during the last two weeks of July, 2015. The flooding has submerged massive areas of the country, twelve out 14 divisions and four states and regions have been declared as "natural disaster affected areas." Up to August 5, 2015, death toll from severe flooding across Myanmar rose to 69, with 259,799 people affected by the disaster so far (Ministry of Social welfare, Relief and Resettlement report, 2015).

The security of the Myanmar population is clearly affected in a negative way by climate anomalies. Intensified cyclones, sea level rise, temperature increases, and rainfall variability are primary effects that are expected in the coming decades, with secondary effects that include altered agricultural growing seasons, decreases in sea and river fishery stock, and forced human migration. Climatic changes will affect agriculture production, habitability of low lying and coastal areas, the availability of portable water. Regional changes are likely to have major impacts on Myanmar as well, as changes to the level, temperature, and pH balance of the Indian Ocean and Bay of Bengal reach Myanmar's vast coastline, and as shrinking mountain glaciers in the Himalayas affect water supplies of the Ayeyarwady river and other rivers that support the natural environment (Slagle, 2014).

Climatic changes will affect the prevalence and spread of vector-borne disease as insect vectors tend to be more active at higher temperatures. For example, tropical mosquitoes such as *Anopheles* species, which transmit malaria, require temperatures above 16°C to complete their life cycles. Some vector borne diseases such as malaria are also thought of as water-vectored diseases, since mosquitoes typically thrive in aquatic habitats, where they lay their eggs in water-filled containers. Thus, epidemics of malaria tend to occur during rainy seasons in the tropics. Malaria has been considered as national concern together with HIV and TB and treated as a priority in our country (Table 1) (WHO, 2015). It is endemic in 284 out of 330 townships in Myanmar. It is a remaining public health problem due to climatic and ecological changes, population migration who are seeking economic opportunities in rural economic frontier areas and economic development activities such as forestry, mining, plantations and road-building and development of multi-drug resistant *Plasmodium falciparum* parasite. Morbidity and mortality rate were 24.35/1000 population and 12.62/100,000 population respectively in 1990 and 6.44/1000 population and 0.48/100,000 population respectively in 2013. Our Ministry of Health (MOH) is carrying out Malaria control activities by providing information, education and communication, implementation of ecological and community surveillance and early case detection and management with ACT (Artemisinin based combination therapy) and preventive measures like indoor residual spraying and promoting personal protective measures such as distribution of long lasting insecticide nets (Health in Myanmar, 2014).

Table 1. Millennium Development Goals in Myanmar



(WHO, 2015)

Dengue is another mosquito-borne disease that present as a health burden in many countries especially the Southeast Asia countries including Myanmar. It is a fast growing infectious disease and number of dengue cases reported in many countries in Asia is higher in 2013 compared to same period in 2012. Numerous factors such as higher temperature, increasing population densities and greater local and international travel contribute to the increase in dengue cases and geographical expansion of the affected countries (WHO, 2013). The first surge of dengue cases in Myanmar was in 1970. In 2001, Myanmar had its largest outbreak of dengue—15,361 reported cases of dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS), including 192 deaths. That year, 95% of dengue viruses isolated from patients were serotype 1 viruses belonging to two lineages that had diverged from an earlier, now extinct, lineage sometime before 1998. Among all the patients who are suffering from dengue, half of them had primary infection and in patients with secondary infection, dengue shock syndrome (DSS) was more common. Accompanying the change in the relative proportions of dengue virus serotypes recovered from patients in the Yangon Children's Hospital was a significant change in the relative proportion of clinically diagnosed DHF and DSS cases (1998: 3,194 DHF, 1,402 DSS; 1999: 1,741 DHF 601, DSS; 2000: 896 DHF, 224 DSS; 2001: 4,511 DHF,1,105 DSS), i.e., DSS occurred in a smaller proportion of patients in 2000 and 2001 than in 1999 or 1998 (Thu HM *et al.*, 2004).

Table 2.Annual dengue haemorrhagic cases in Myanmar

Y	Cases	Y	Cases	Y	Cases	Y	Cases
1970	1,654	1978	2,029	1986	2,114	1994	11,647
1971	691	1979	4,685	1987	7,331	1995	2,218
1972	1,013	1980	2,026	1988	1,178	1996	1,854
1973	349	1981	1,524	1989	1,196	1997	4,006
1974	2,477	1982	1,706	1990	6,318	1998	12,918
1975	6,750	1983	2,756	1991	6,770	1999	5,755
1976	3,153	1984	2,273	1992	1,685	2000	1,816
1977	5,364	1985	2,666	1993	1,979	2001	15,361

(Thu HM *et al.*, 2004)

According to Theingi Win Myat study in 2013, out of 1133 samples (868 acute phase sera and 265 paired sera) were collected from patients with Dengue /DHF attending Yangon Children Hospital and Yankin Children Hospital between May 2012 and June 2013 by using test method ICT and ELISA, 727(64%) showed seropositive results, comprising 212(29%) of primary dengue infection and 515(71%) of secondary dengue infection. The most common affected age group 5-8yrs .23 out of 29(79%) of children developed primary Dengue infection where as secondary Dengue infection occurred in 9-12 year age group, accounting for 84%(145/172). The peak admission was found in June ,2013 during this study period. Genotype sequencing showed that currently circulating Myanmar DENV-1 belonged to the Genotype I (Asian Genotype) and close relationship to viruses isolated from Thailand from the year 2006 and China 2006 strains (Theingi Win Myat, 2013).

Since there is no particular treatment for dengue, vector control is highly essential. Innovative preventive approaches are prerequisite in preventing dengue at community level. Generally, all the countries including Myanmar are practicing vector control method to control and prevent the outbreak of dengue fever. This is a disease that requires behavioral change that emphasize on the social mobilization and communication activities to prevent and control dengue transmission (WHO, 2009). In Myanmar and Laos, WHO promoted a strategy to manage the problem of dengue affliction by using the biological vector control example guppy fish (*Poecilia reticulate*). Guppy fish eats mosquito larvae and it is placed in common habitat of *Aedes* such as water tanks, ponds and other areas where plenty of water are kept in. The project is targeted in the neighborhood and in schools where dengue cases are common. At community level, public were educated and encouraged to take part in every stages of the project. Control programmes constitute of labor intensive house to house manual inspection for mosquito larvae. The prevention methods are mainly divided into environmental control and mechanical control in which the former involves abolishing, flipping over and evacuating any items that can contain large amount of water while the later involves altering plans of homes and taking out sprinkle canals (WHO, 2013).

Like vector borne diseases, waterborne infectious diseases such as bacterial and protozoal diarrhea, hepatitis A, and typhoid fever, leptospirosis are also strongly affected by climate. During times of drought, water scarcity results in poor sanitation and much of the population can be exposed to potentially contaminated water. Like drought, excess rainfall and flooding can also contribute to epidemics of waterborne infectious diseases, in this case due to poor sanitation resulting from runoff from overwhelmed sewage lines or the contamination of water by livestock. In 1994, *Vibrio cholerae* O139 was detected in outbreaks in some townships of Yangon Division and reported cholera cases among diarrhoea cases in Yangon Division were: 4 cases, 49 cases and 191 cases in 2007, 2008 and 2009 respectively,719 isolates of *V. cholerae* were identified (National Health Laboratory, 2009). In Toe Sandar study, *Vibrio cholera* O1 in 49 cases (23%) and non O1 non O139 in 14 cases (6.6%) out of 213 cases from medical wards of Yangon general hospitals (Toe Sandar, 2013).

Similar to these common infectious diseases, there is impact of environmental sanitation on soil-transmitted helminthiasis, one of neglected tropical diseases in Myanmar. STH causes the highest burden among all neglected tropical diseases (NTDs). Total DALYs lost annually may range from 4.7 million to 39 million (Bethony *et al*., 2006). Warm climates and adequate moisture are essential for the hatching of STH eggs to develop as larvae. Important contextual determinants for human infection are poverty, lack of sanitation and inadequate hygiene, increased population density, and poor health awareness (Brooker *et al*., 2006). Helminthic infection often leads to iron deficiency anaemia, protein energy malnutrition, growth stunting, abdominal pain, intellectual retardation, cognitive and educational deficits (WHO, 2005).

Ministry of Health (MOH) of Myanmar conducted a country wide national survey in 2002-2003 on the prevalence and intensity of STH in school age children in four ecological areas of the country, namely plain, hilly, delta and costal areas of Myanmar. An overall prevalence of infection of STH was 69.7%, 18% had moderate-heavy intensity of infection and 22% were anaemic and the prevalence of any STH was highest in delta (92%) and lowest in hilly region (28.1%). They found that *Trichuris trichiura* was the most commonest infection (57.5%), followed by *Ascaris lumbricoides* (48.5%), Hookworm (6.5%) respectively (Thet-Thet-Zin *et al*., 2003).

Based on the results of the survey, Mass Drug Administration (MDA) was started by giving single-dose of albendazole 400 mg since 2002 with support of WHO and German Pharma Health fund and later by UNICEF. MDA was targeted for pre-school (2-5 years) and primary school children (5-9 years).Targeted population was 37.1 million and there was coverage of 15.8 million in 2008. All the pre-school and primary school children are currently dewormed twice a year (in areas where prevalence of infection is 50% and above) and once a year (in areas where prevalence of infection is $\geq$ 20% and <50%). It was practiced in January or February before the schools are closed for 3 months summer holidays and next time is in July or August as part of School Health Programme (NTD Report, MOH, Myanmar).

Seven years after implementation, Aung Tun *et al.* conducted a study targeted on same areas of the above study and found that a significant reduction of any STH prevalence (21%), and prevalence of *Trichuris trichiura* (18.6%), prevalence of *Ascaris lumbricoides* (5.8%), prevalence of Hookworm (0.3%) as well as reduction of infection of moderate-heavy intensity from 18.5% to less than 7%. (Aung-Tun *et al*., 2013).

Our department of Microbiology, University of Medicine 1 carried out collaborative study with Department of Virology, Parasitology and Immunology, Faculty of Veterinary Medicine, Ghent University, Ghent, Belgium on STH during 2013-2014. The type of study was cross-sectional study including 60 school children each from 12 Basic Education High schools of 12 different urban and periurban townships in Yangon and the students were stratified in two age groups (5 - 9 years and 10 - 15 years) to determine the prevalence and intensities of STH by modified McMaster method. In this study, fecal samples from 360 periurban students were collected for 5 times. The first collection was done in January 2013 (sampling period 1-SP1) before starting first round of Mass Drug Administration (MDA) and same children were collected again within 7-21 days after treatment (SP2). SP3 was done 6 months after MDA in 2013 and SP4 was done within 7-21 days after second round of MDA in 2013. Last sampling period was in January 2014 before next MDA. In addition, fecal samples from 360 urban students were collected at SP3 and SP4.The short term (7-21 days) and long term (6 months and12 months) impact of a single dose of Albendazole (400 mg) in terms of fecal egg count reduction (FECR) was evaluated in 360 periurban school children.

The prevalence of STHs in the 6 periurban schools at SP1 was 16.9%. *T. trichiura* was the predominant species (15.3%), followed by *A. lumbricoides* (4.7%) and hookworm (<1%). The arithmetic mean of fecal egg count (FEC) was 411.8 egg per gram (EPG) (0-45,550), 66.4EPG (0-2,500) and 0.42 EPG (0-100) for *A. lumbricoides, T. trichiura* and hookworm, respectively. Among 12 schools, there was large variation both in prevalence of any STH infection (6.7% to 20.0%) and in prevalence of each of the three STHs (6.7% to 35.0% for *T. trichiura;* 0% to 20% for *A. lumbricoides*; and 0% to 1.7% for hookworm). Between the two age groups, there was a remarkable difference in prevalence of STHs (age group 6 to 9 years: 7.4% *vs.* age group 10-15 years: 26.1%), highlighted that older school children should be included in current MDA program in which only less than 10 years old students are included.

Prevalence was higher in children from urban townships compared to children from periurban township at SP3. Any STH were found in 18.3% of the children in urban townships, whereas only 5.8% of the children of the periurban townships were excreting any of STH eggs. For *T. trichiura* and *A. lumbricoides* the prevalence were 4.0% and 1.7% for children in periurban townships, respectively, and 16.1% and 7.2% for children in urban townships. Assessment of prevalence and infection intensity of STH infections over one year (2013-2014) showed that there was changes in prevalence and infection intensity of STH infections over the five sampling periods within 2013- 2014 . Overall, the prevalence of any STH dropped stepwise from 16.8% (SP1) over 10.7% (SP3) to 7.0% (SP5), with a steep drop in prevalence shortly after drug administration treatment (SP2: 7.0%; SP4: 4.8%). After one year, the prevalence of any STH was 42.7% of the prevalence at SP1. A similar pattern was observed for prevalence and intensity of *T. trichiura* and *A. lumbricoides* infections. For *T. trichiura*, the prevalence dropped from 15.2% to 6.7% (44.1% of prevalence at SP1), the mean FEC from 66.3 EPG to 13.3 EPG (20% of the mean FEC at SP1). For *A. lumbricoides*, the prevalence dropped from 4.8% to 0.8% (16.7% of the prevalence at SP1), the mean FEC from 446.8 EPG to 5.6 EPG (1.3% of the mean FEC at SP1) (Table 3) (Myo Pa Pa, 2014).

Table 3. Prevalence and infection of any STH, *Ascaris lumbricoides* and *Trichuris trichiura* across 5 consecutive sampling periods (SP)

	STH		*Ascaris lumbricoides*				*Trichuris trichiura*			
SP	Prevalence	SP1/SP2	Prevalence	SP1/SP2	Mean FEC	SP1/P2	Prevalence	SP1/SP2	Mean FEC	SP1/SP2
1	16. 8	-	4.	-	446. 8	-	15.2	-	66.3	-
2	7.0	41.7	0.5	10.4	8. 3	1.9	6.7	44.1	17.4	26.2
3	10.7	63.7	2.5	52.1	71. 6	16. 0	9. 8	64.5	28.9	43. 6
4	4.8	28. 6	0. 6	12.5	4. 6	1.0	4.5	29.6	4.1	6.2
5	7.0	42.7	0. 8	16.7	5. 6	1.3	6. 7	44.1	13.3	20.0

(Myo Pa Pa, 2014)

The prevalence of STH, and each of the two STH species separately, differed significantly between urban and peri-urban township. Some of the urban townships selected in this study has high population density and cultural differences were found in some townships. The results of this study showed that prevalence of infection varied according to the population density, socioeconomic status and environmental sanitation, valueness of personal hygiene more than drug treatment alone.

The main risk factors for infection include houses without cement floors, poor household hygiene, poor socioeconomic status, cultural factors, poor water supply,maternal employment status, lack of potable drinking water, poor latrines and children walking barefooted. Other factors are overcrowding and lack of proper environmental sanitation in both urban and periurban centers. High worm burdens are the result of frequent infections and re-infections acquired through contact with or ingestion of infected matter. Therefore it should be aware that treatment alone is not sufficient to reduce disease burden and the risk factors for STH should also be taken into account to control infection rather than treatment alone and above factors are needed to be improved in both urban and periurban areas.

The soil-transmitted worm, *Strongyloides stercoralis*, is one of the most neglected among the so-called neglected tropical diseases (NTDs) and there were only few studies in Myanmar. In Myanmar, Khin-Ohn-Lwin and Min-Zaw study (1981) on Geohelminths in Moulmein and Monywa showed that the prevalence of Strongyloidiasis was 15.38% in those areas. The difficulty of diagnosing *Strongyloides stercoralis* infections is the reason why up to date, accurate information on its geographic distribution in endemic regions and the total global burden is lacking.

The detection of *S. stercoralis* larvae in the stool is proof of an infection. The relatively poor sensitivity of single stool evaluations, which is further lowered when quantitative techniques aimed at detecting eggs are used, also complicates morbidity evaluations and adequate drug efficacy measurements, since *S. stercoralis* is eliminated in stools in a larval stage. The unique ability of this nematode to replicate in the human host permits cycles of autoinfection, leading to chronic disease that can last for several decades. Although most infected individuals are asymptomatic but all patients are at risk of developing complicated strongyloidosis, particularly if they become immunosuppressed. During recent years, several cases of *S. stercoralis* hyperinfection syndrome in AIDS patients have been reported. (Grove, 1996).

Recently, we did collaborative research with Division of Parasitology, Department of Infectious Diseases, Faculty of Medicine, University of Miyazaki on prevalence and worm genomic diversity of *Strongyloides stercoralis* by using culture method and genomic sequencing during January 2014 and January 2015. The study was carried out in two townships in Yangon division and one township in Ayeyawady division. It was found that highest prevalence of infection was found in Htantapin township (14.4%) out of 195 followed by Thanlyin (2.5%) out of 237 and Thabaung township (2.2%) out of 237 people respectively. The study population residing in Htantapin township were mostly farmers who usually do not wear shoes with relatively low environmental sanitation than other two townships (Table 4) (Nagayasu *et al.*, 2015).

Table 4.Prevalence of *Strongyloides* in lower Myanmar

Strongyloidiasis prevalence based on agar plate culture followed by 18s rDNA sequencing

	Sampling site			combined
	HTB	TBN	TLY	
Sample number	195	271	237	703
Positive cases	28	6	6	40
(%)	14.4%	2.2%	2.5%	5.7%

(Nagayasu *et al.*, 2015)

WHO stresses the importance of STH control using a combination of chemotherapy, benzimidazoles/ivermectin and improved living conditions. Most recent control programmes have focused on chemotherapeutic based options for control as they have been proven to be the most cost effective and easy to implement. The control of morbidity due to soil-transmitted helminthiasis and schistosomiasis in poor communities is now a realistic possibility because low-cost, safety-tested drugs are widely available. Importantly, these drugs should be given regularly and can be given concomitantly in integrated control programmes. Deworming undoubtedly makes a significant contribution to the education of children, and in so doing to a nation's development (WHO, 2005).

Provision of clean water and improved sanitation decreases the transmission of infection by reducing contact with soil and water contaminated by helminthes eggs. Schools, particularly those in rural areas, often lack clean drinking water and adequate sanitation facilities. Coupled with behavioral changes, better sanitation and water supply are long-term measures that sustain the health improvement of school children. Every year, thousands of teachers in endemic countries take a leading role in administering deworming drugs and providing health education message to school - age children. By including health education on personal hygiene and prevention of worm infection in school curricula and by raising sanitation standards in school system can contribute substantially to the improvement of the health of school children. Children's parents, families and communities also play an essential role. With the active backing of other advocates such as Ministry of Health, Ministry of Education and non governmental organization, families furnish substantial support for school deworming program leading to well being of children (WHO, 2011).

Further progress in health and well being requires not only health system strengthening and financial protection but also policy coherence and shared solutions across many sectors in Myanmar. Unfailing our Ministry of Health will maintain the commitment to further its collaboration with various sectors to ensure achieving the Universal Health Coverage.

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