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A Household Level Analysis of Water Sanitation Associated with Gastrointestinal Disease in an Urban Slum Setting of South Okkalapa Township, Myanmar

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Abstract

This research analyzed the prevalence of water sanitation at the household level against gastrointestinal disease occurrence in the urban slum setting of South Okkalapa Township, Myanmar, using cross-sectional study design techniques. A total of 364 household respondents were interviewed face to face by well-trained research assistants using structured questionnaires. Chi-square tests and multiple logistic regression analyses were used to determine the association between independent and dependent variables. Results showed that the source of household water (OR: 13.58, 95% CI: 6.90-26.74), and the types of drinking water (OR: 1.85, 95% CI: 0.92-3.71), were significantly associated with gastrointestinal diseases (p-value<0.05). After adjustment for confounding factors, this study found that occupation (AOR: 2.63, 95% CI: 1.25-5.54), employment status (AOR: 2.25, 95% CI: 1.01-5.01), type of household toilet (AOR: 8.66, 95% CI: 4.03-18.60), sources of household water (AOR: 6.56, 95% CI: 2.86-15.08), and the method of vector control (AOR: 3.12, 95% CI: 1.37- 7.30) were all significantly associated with gastrointestinal diseases (p-value<0.05). Health education and appropriate technology for household water, sanitary latrines, environmental sanitation and waste disposal, and the implementation of policies focusing on systematic water management are therefore urgently required to control the spread of waterborne diseases.

Keywords: water sanitation; gastrointestinal diseases; slum setting; household level; Myanmar

1. Introduction

Gastrointestinal diseases are caused by pathogenic microorganisms that are commonly transmitted by contaminated fresh water. The World Health Organization (WHO) estimate that gastrointestinal diseases account for 1.8 million human deaths, or 4.1% of the total global disease burden annually (WHO, 2014). Nowadays, problems of morbidity and mortality caused by gastrointestinal illness have global dimensions in both developing and developed countries (WHO and UNICEF, 2012). Eighty-eight percent of gastrointestinal diseases are attributable to unsafe water supply, poor sanitation, and low hygiene (WHO, 2014). Moreover, diseases related to inadequate water, sanitation, and hygiene are a huge economic burden for developing countries (Adams and WHO, 2009). The chief pathogens associated with gastrointestinal disease are mainly transmitted by ingestion of fecal contaminated food and water. It is estimated that 94% of gastrointestinal disease can be attributed to environmental factors, such as a lack of proper sanitation and hygiene, and unsafe drinking water (Hlaing, 2008; Chen *et al*., 2013; Laine *et al*., 2014; Hansdotter *et al*., 2015). At least one third of the population in developing countries, and almost one fifth of the global population have no access to safe drinking water. Water related diseases continue to be a major global health problem (WHO, 2013).

The WHO 2013 report stated that 14 million people in Myanmar do not have access to a systematic safe water supply system (BOBLME-Ecology13, 2011). In Yangon, the ever increasing urbanization and population expansion result in the deficiency of both quantity and quality of the water supply. Sixty percent of the people in Yangon use tap water, pipe water and shallow water (YCDC, 2009). During November 2014, a sporadic gastrointestinal outbreak occurred in a slum area of South Okkalapa Township. The local health authority reported that 216 gastrointestinal patients of all age groups were hospitalized within three days of the outbreak. This area is mainly uses of water source from surface water including rivers, streams, ponds, and lakes and some are using tube water. Second most commonly used source is the ground water including shallow and deep wells. Yangon urbanization is associated with use of Ground water. But, in the great city like Yangon, Surface water is used again for its

main water supply. Now a day, they get the municipal water supply and proper disposal waste management under the supervision of township health department and Yangon municipal committee.

The provision of basic drinking water and sanitation services to the poorest people in semi-urban and slum areas is of the utmost importance to prevent outbreaks of cholera and other water-related diseases in these often overcrowded places (WHO, 2013). Slums are usually considered as unplanned settlements, with inadequate access to safe water, sanitation, quality housing, and other infrastructure; they are generally overcrowded with insecure residential status (UN-HABITAT, 2003; Keraka and Wamicha, 2003).

From the public health point of view, strategies are required to reduce and transform slums in different countries, and support adequate water supplies that must be free from all types of impurities. Supplying water to the world's poor has been high on the agenda of the international community for decades, however lack of universal access to urban water supply has persisted, despite sustained and significant investment by bilateral aid agencies and multilateral financial organizations (Bakker *et al*., 2008).

For these reasons, this research aimed to describe the factors that related to gastrointestinal disease occurrence, and the prevalence of household water related to gastrointestinal diseases. The understanding of, and perception about water hygiene and sanitation, and its relationship with the occurrence of gastrointestinal diseases in slum settings will be useful for Local Government, Ministry of Health and other stakeholders, to develop an action plan to deliver adequate water supply and environmental sanitation. This study also aimed to indentify the knowledge and safe water hygiene practices of the people living in the slum areas, and thereby to suggest the reduction approach of the morbidity caused by gastrointestinal diseases.

2. Material and Methods

2.1 Data collection

A cross-sectional study design was used to determine the factors affecting the water sanitation association with gastrointestinal diseases for slum dwellers in South Okkalapa, Yangon. Gastrointestinal diseases in this study refer to Diarrhea, Dysentery and other related diseases. Disease occurrence and severity in each family, socioeconomic and household facilities, and knowledge and perception of water utilization were considered. This study was approved by the International Review Board of Social Sciences, Mahidol University (COA No. MU-SSIRB 2015/141.2204), and the Institutional Review Board of Defense Services Medical Research Center (IRB/2015/37). Informed consent was obtained from all participants. The respondents eligible for study were slum dwellers aged 18 years and older more than one year who were representatives of the households living in the area. The total number of households in South Okkalapa was 2,340 in January 2015. The estimated sample size was 364 respondents from every household using 95% confidence interval, and the estimated proportion of good gastrointestinal preventive behavior for maximum sample size was 0.5. A sample technique was shown in Fig. 1 and was purposively selected from this township because of the cluster population in slum settings. This area has four quarters, 204 respondents from 2 quarters and 80 from each quarter. The 364 respondents from each household were selected by simple random sampling from a population of about two thousand. Probability sampling technique for household by using bottle by twisting circle on the ground and chose the heading pointing direction follow to select the households. Collect the data started from pointed house to ever third house and got 100% response rate in the study area.

All of the data collectors are medical doctors and they know well about diseases symptoms to differentiate from others diseases such as contents of stool (Bloody, Mucus, Watery, Semi-solid, others), history of Diarrhea, and Dysentery and other related diseases including heartburn, diverticulitis, irritable bowel syndrome, cramps, nausea, vomiting, fever and current medical causes.

2.2 Data instrument

The section on general information, and the occurrence and severity of the disease consisted of 12 questions about the number of family members, age, gender, marital status, educational level, onset of gastrointestinal disease and its symptoms. The socio-economic characteristics section was composed of 11 questions, concerning occupation and family income per month, family members, and their properties. Knowledge of household water utilization and gastrointestinal diseases comprised 16 questions, concerning the quality of drinking water, hand washing, causes of water pollution, water borne diseases, and water treatment methods for household drinking water. The perceived obstacles and benefits were divided into three groups according to the percentile of the scores (P), Poor < 60%, Fair = 60-80%, and Good > 80%. Water sanitation was composed of 14 questions concerning the perception for drinking

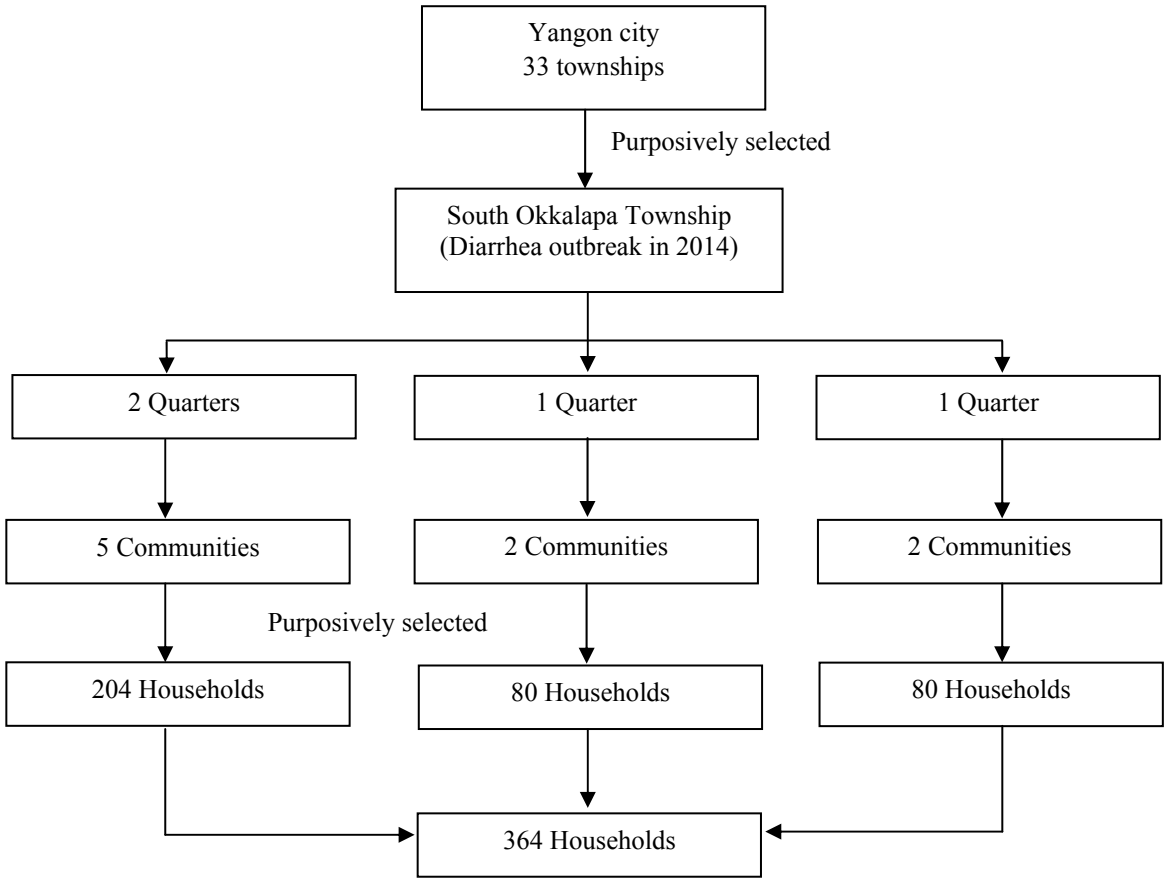

Figure 1. Sampling diagram of the study

purpose, storage for drinking purpose, benefit of hand washing, food hygiene, and flies and finger transmission of gastrointestinal diseases. The negative questions were given scoring vice versa according to Likert's Scale. The total scores were from 14-70. The perceived obstacles and benefits were then divided into two groups according to the percentile of the scores (P). The positive level was $\geq P_{75}$ and the negative level was $\leq P_{75}$. The results of the reliability test for Cronbach's Alpha gave 0.805 and for KR20 was 0.60. After pre-testing the questionnaire, the study team reviewed the questionnaire to incorporate changes such as wording and rearrangement of questions.

2.3 Data analysis

The collected data was analyzed using SPSS program version 1.6. The distribution of preventive behavior, socio-economic characteristics and the level knowledge and of the respondents was summarized by using descriptive statistics. Chi square test is used for the analysis of the association between water knowledge, perception and the occurrence of gastrointestinal diseases. Multiple logistic regression tests were used to find predictor variables, *p* value less than *0.05* is considered statistically significant.

3. Results

The social demographic characteristics of the 364 respondents in the households were as follows (Shown in Table 1): A total of 80.5% of respondents were female (293) and 19.5% were male (71). Females were the majority group of the respondents. Regarding education, the ability to read and write was 4.1%, Primary 27.5%, Middle 38.2%, High 25.0%, and Graduated 5.2%. For socio-economic and household facilities, low family income was 53.0% and high 47.0%. Those in permanent work were 66.8% and temporary work 33.2%. Buddhists were 90.1% and non-Buddhists 9.9%.

Table 2 shows the temporary housing at 68.4%, and permanent types of housing at 31.6%. Water sealed latrines were used by 83.8% and unsanitary latrines by16.2%. Tube water utilization was 86% and non-tube water 14%. Boiling water before drinking was done by 20.1%, and non-boiling 79.9%. Garbage disposal by burying in the ground was 6.3%, with non-burying at 93.7%. Fly control methods were 35.7%, and no control 64.3%.

Table 3 shows the gastrointestinal disease per total household at 22.8%, and non-disease 77.2%. Concerning knowledge and perception (Shown in

Table 1. Number and percentage of respondents by socio-demographic factors

Socio-demographic factors	Number	Percent
Age group (years)		
18-30	87	23.9
31-40	144	39.6
41-50	82	22.5
51-60	33	9.1
61-70	18	4.9
Median = 38, Min = 18, Max = 70		
Gender		
Female	293	80.5
Male	71	19.5
Marital status		
Single	41	11.3
Married	285	78.3
Divorced	7	1.9
Widow	22	6.0
Separate	9	2.5
Education		
Read and Write	15	4.1
Primary	100	27.5
Middle	139	38.2
High	91	25.0
Graduated	19	5.2
Family income		
Low income	193	53.0
High income	171	47.0
Occupation		
Manual	135	37.1
Non manual	229	62.9
Employment status		
Permanent	243	66.8
Temporary	121	33.2
Religion		
Buddhists	328	90.1
Non buddhists	36	9.9

Table 4), the respondents indicated that mostly respondent's knowledge (70.3%) and perception (94.8%) were high knowledge and high perception on household water sanitation association with gastrointestinal diseases, respectively.

Table 5 lists the seven significant variables as occupation, employment status, types of household toilet, sources of household water, method of water storage, fly/vector control habit, and methods of fly control (p-value<0.05).

Firstly, as shown in Table 6, the occupation of manual and other labor was significantly associated with gastrointestinal diseases (p-value<0.05). In addition, multiple logistic regression analysis confirmed that manual laborers were 2.6 times more likely to contract diseases than other labor (OR: 2.633, 95% CI: 1.252-5.538). Secondly, the employment status for both temporary and permanent workers was found to be significantly associated with gastrointestinal diseases (p-value<0.05). Furthermore, temporary workers were 2.2 times more likely to contract diseases than permanent workers (OR: 2.249, 95% CI: 1.011-5.007). Thirdly, household toilets with unsanitary latrines and water sealed latrines were strongly associated with gastrointestinal diseases (p-value<0.001). In addition, households with unsanitary latrines were 8.6 times more likely to contract disease than those with water sealed latrines (OR: 8.658, 95% CI: 4.033-18.588). Fourthly, the sources of non-tube water and tube water were also strongly linked with the occurrence of gastrointestinal diseases (p-value<0.001). Furthermore, households using non-tube water were 6.5 times more likely to contract gastrointestinal diseases than those using tube water (OR: 6.564, 95% CI: 2.857-15.082). Lastly, fly/vector control methods for smoke/insecticide spray were a significant predictor for gastrointestinal diseases (p-value<0.05). Lastly, households that did not control flies were 3.1 times more likely to contact gastrointestinal diseases than those that used smoke/insecticide spray (OR: 3.123, 95% CI: 1.336-7.299).

Table 2. Frequency and percentage of respondents by household sanitation

Household sanitation	Number	Percent
Types of household		
Temporary	249	68.4
Permanent	115	31.6
Types of household toilet		
Water sealed latrine	305	83.8
Unsanitary latrine	59	16.2
Sources of household water		
Tube water	313	86
Non-tube water	51	14
Types of drinking water		
After boiling	73	20.1
Non boiling	291	79.9
Methods of storage water		
Container with cover	214	58.8
Container without cover	150	41.2
Methods of garbage disposal		
Buries under the ground	23	6.3
Non buries under the ground	341	93.7
Control of flies in household		
None	234	64.3
Anti-fly/vector smoke	48	13.2
Insecticide spray	69	19.0
Traditional methods	13	3.6

Table 3. Number and percentage of gastrointestinal diseases in total household

GI disease per total household	Number	Percent
Disease	83	22.8
Non disease	281	77.2
	364	100

Table 4. Number and percentage of knowledge and perception levels on household water sanitation association with gastrointestinal diseases

Items	Number	Percent
Knowledge level		
Low knowledge	108	29.7
High knowledge	256	70.3
Median =3.00, Min =1.00, Max =3.00		
Perception level		
Low perception	19	5.2
High perception	349	94.8
Median = 2, Min = 1.9478, Max = 2		

Table 5. Association between independent variables and gastrointestinal diseases

Independent variables	GI Diseases			Crude OR	95% CI	*p*-value
	N	Yes (%)	No (%)			
Age group (years)	364					
More than 38	179	22.9	77.1	1		
Less than 38	185	22.7	77.3	1.01	0.62-1.65	0.963
Gender	364					
Male	71	18.3	81.7	1		
Female	293	23.9	76.1	1.40	0.73-2.71	0.316
Marital status	364					
Married	323	22.6	77.4	1		
Unmarried	41	24.4	75.6	1.11	0.52-2.36	0.797
Education	364					
Middle and above	249	25.3	74.7	1		
Primary and below	115	17.4	82.6	1.61	0.92-2.82	0.096
Family income	364					
High income	193	23.3	76.7	1		
Low income	171	22.8	77.2	0.94	0.58-1.54	0.804
Occupation	364					
Other jobs	229	17.5	82.5	1		
Manual labour	135	31.9	68.1	2.21	1.34-3.63	0.002*
Employment status	364					
Permanent	243	26.3	73.7	1		
Temporary	121	15.7	84.3	1.92	1.09-3.38	0.024*
Religion	364					
Non buddhist	36	19.4	80.6	1		
Buddhist	328	23.2	76.8	1.25	0.53-2.96	0.614
Types of household	364					
Others types	115	20.0	80.0	1		
Temporary housing	249	24.1	75.9	1.27	0.74-2.18	0.387
Types of household toilet	364					
Water sealed latrine	305	12.8	87.2	1		
Unsanitary latrine	59	74.6	25.4	20.01	10.18-39.31	0.000*
Sources of household water	364					
Tube water	313	15.0	85.0	1		
Non-tube water	31	70.6	29.4	13.58	6.90-26.74	0.000*
Types of drinking water	364					
Boiling	73	15.1	84.9	1		
Non-boiling	291	24.7	75.3	1.85	0.92-3.71	0.082
Methods of storage water	364					
Container with cover	214	15.9	84.1	1		
Without cover	150	32.7	67.3	2.57	1.56-4.24	0.000*
Methods of garbage disposal	364					
Buries under the ground	23	21.7	78.3	1		
Non-buries	341	22.9	77.1	1.07	0.38-2.97	0.900
Flies control habit	364					
Usually done	129	9.3	90.7	1		
Never	235	30.2	69.8	4.22	2.19-8.13	0.000*
Method of fly/vector control	364					
Smoke/Insecticide spray	117	6.8	93.2	1		
Never	247	30.4	69.6	5.94	2.76-12.80	0.000*
Knowledge						
High	256	21.1	78.9	1		
Low	108	26.9	73.1	1.37	0.82-2.31	0.233
Perception						
High	345	22.3	77.7	1		
Low	19	31.6	68.4	1.61	0.59-4.37	0.353

Gastrointestinal diseases (event),*p-value<0.05, **p-value<0.01, ***p-value<0.001

Table 6. Final model of multiple logistic regressions

Variables	Adj. OR	95% C.I for OR		*P*-value
		Lower	Upper	
Occupation				
Other jobs	1			
Manual labour	2.63	1.25	5.54	0.011*
Employment status				
Permanent	1			
Temporary	2.25	1.01	5.01	0.047*
Types of household toilet				
Water sealed latrine	1			
Unsanitary latrine	8.66	4.03	18.59	<0.001***
Sources of household qater				
Tube water	1			
Non-tube water	6.56	2.86	15.08	<0.001***
Method of fly/Vector control				
Smoke/Insecticide spray	1			
Never	3.12	1.37	7.30	0.009*

Gastrointestinal diseases (event), *p-value<*0.05*, **p-value<*0.01*, ***p-value<*0.001*

4. Discussion

The prevalence of gastrointestinal disease was found in 83 households (22.8%), and non-disease in 281 households (77.2%). The occurrence of one case per household was 17.0%, two cases per household were 5.5%, three cases per household was 0.3%, and no disease was 77.2%. The presence of gastrointestinal disease in the total population of 364 households was 105 cases (7.2%) and non-disease 1446 (92.8%). A study in a slum area of Lucknow City, India in 2013 found that 11.25% of the people living there were suffering from gastrointestinal diseases (States of the World Cities Report 2012/2013, 2014).

In this study shows, family income of low and high were equal. Low income was set at under 100,000 kyat and high income above 100,000 kyat. The international poverty line is set at roughly US$1 a day per person. Monthly income averaged 100,000 kyat, or 3,000 kyat per day (US$3). If the family consisted of three people, this equated to US$1 for each person. If the family was composed of more than three people, then they were below the international poverty line. Most of the families were of low socio-economic standard and the breadwinner did not have a permanent job, as employment opportunities were limited. The economy has a significant impact on the prevalence of gastrointestinal diseases, both locally and internationally. On average, a family spends about 10% of the monthly household income per person infected (Schnabel, 2014).

The types of household showed no statistical significance in this study, but strength of association indicated that those living in temporary households were 1.2 times more likely to contract disease than permanent house dwellers (OR 1.270) (CI 0.74-2.18). Types of household toilet had statistical significance (p-value<*0.001*); association with unsanitary latrines was 8.5 times more likely to contract disease, compared to water sealed latrines (OR 8.576) (CI 3.93-18.70). Types of household water had statistical significance (p-value<*0.001*); association with non-tube water was 6.5 times more likely to contract disease compared to tube water (OR 6.564) (CI 2.97-15.99). Methods of water storage had no statistical significance, but showed strength of association that water storage containers without covers were 1.8 times more likely to contract gastrointestinal diseases, compared to storage containers with covers (OR 1.861) (CI 0.98-3.53).

Diseases related to inadequate water, sanitation, and hygiene are a huge economic burden for developing countries. It has been estimated that 88% of gastrointestinal disease is caused through unsafe water supply, and inadequate sanitation and hygiene (Adams and WHO, 2009). Similarly, a study on the Jakarta water supply system in Indonesia in 2008 demonstrated that gastrointestinal disease was highly associated with economic status. The WHO estimates that 1.1 billion people worldwide do not have access to safe drinking water and safe water supply (Bakker *et al*., 2008).

In this study, five independent variables were found to be statistically significant. Firstly, nearly 40% of the people were manual laborers, and many did not have a permanent job. Therefore, they were always looking for a new job to earn more money; most worked at construction sites, small machinery factories, cargo services in harbors, and local bazaars. They normally ate and drank low hygiene quality food and drink. They therefore had a greater chance of contacting gastrointestinal diseases. Secondly, employment status was also significant. Most were temporarily employed dependent on job opportunities. This indicated that employment status was also related to gastrointestinal illness, because people living in the slum do not have permanent jobs; they moved to more favorable places for better employment opportunity.

Thirdly, types of household toilet were strongly significant in this study. This variable relates to the socioeconomic standard, education, and personal hygiene of the people living in slums. Even if they have knowledge of health education, they are hampered by a lack of money. However, they can use a locally made, low cost fly proof/sanitary latrine. In the United States and other countries, studies have confirmed that hygiene education and the use of sanitary latrines can inhibit 20% of gastrointestinal disease incidence (Aiello and Larson, 2002). Fourthly, household water source was also found to be strongly significant. This variable is related with socioeconomic standard and Civil Development Committee policy. Furthermore, in Montreal, Canada, study results determined that systematic tube/tap water supply systems were strongly related to reduction in the gastrointestinal disease prevalence (Payment *et al*., 1991). Likewise, in Melbourne, Australia and other countries, studies have confirmed that there was no evidence of gastrointestinal illness in systematically treated water tube supply systems (Hellard *et al*., 2001). A systematic water supply is essential for every family all over the world. Each and every new settlement should be connected to a safe water supply system.

Finally, the method of house fly/vector control was significant in this study. This is a very important factor for the control of gastrointestinal disease transmission. Houseflies frequently come into contact with food, human excreta, and other unhygienic substances responsible for the dissemination of gastrointestinal diseases (Grübel *et al*., 1997). Furthermore, in the United States, study results concluded that houseflies can harbor gastrointestinal disease agents in their bodies and their intestinal tract. Therefore, they present a significant reservoir, and are a vector in the occurrence of gastrointestinal illness (Grübel *et al*., 1997). The media can be used to implement changes in personal behavior and attitudes to hygiene. The promotion of self-belief is important to sustain a healthy and happy environment.

From the public health point of view, strategies are required to reduce and transform the slum areas in Yangon. Housing projects must support systematic water supplies to the slum areas (Bakker *et al*., 2008). WHO estimates that 94% of gastrointestinal cases are preventable through modifications to the environment, including interventions to increase the availability of clean water, and improve sanitation and hygiene (C PAaC, 2006). Environmental sanitation and safe water supply of adequate quantity in this important city is essential. Long term underinvestment in urban infrastructure including water supply, sanitation, drainage, wastewater, and solid waste management has resulted in seriously deficient urban services throughout Myanmar (Bank, 2013). The urbanization and population of Yangon are both increasing rapidly, and the water supply therefore never meets demand in terms of both quantity and quality.

Hence, this study result should be recommend that Myanmar government should be concerned for provision of adequate water supply, sanitation, hygiene and waste management in urban has a number of positive effects. Government need to be implemented project for people behavior changing program by using media information, self believe thinking for healthy and happy environment around them. Poverty and low health indicators underscore the urgent need to improve basic public health services

Besides, this study was carried out at one quarter of slum setting in South Okkalapa Township, Yangon City, Myanmar, because of its high prevalence of gastrointestinal diseases. It may not generalize for the whole township. It cannot be represented for the whole country results. The causes of gastrointestinal diseases are multi-factorial and difficult to point out the others cause. The information about diseases occurrence may be occurred recall bias for last 6 months ago. The incidence of some gastrointestinal diseases are seasonal and regional, its findings cannot be generalized to the whole year. The weakness of this study includes the following; (1) Based on information given by the respondents, without any confirmation from the attending health practitioner or from any health facility record which can have chances of misinterpretation or misdiagnosis. (2) The data were collected at one time-point, and the risk of some diarrhea diseases varied with the season. (3) Being a cross-sectional study, the point of making causal inferences from the result is limited.

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