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Original article

Prevalence of asthma, dengue, and diarrhea among children in slum communities in Cebu City, Philippines

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ABSTRACT

Economic struggles have forced many families to live in slum areas in spite of the poor environmental condition, which often leads to many ailments. While conventional diseases had been controlled, ailments such as asthma, dengue, and diarrhea among other diseases have also developed due to varying aspects and states of pollution. This study aimed to determine the prevalence of asthma, dengue, and diarrhea affecting children in two slum communities in Cebu City, Philippines as a result of environmental degradation. The study was conducted in Inayawan landfill environs and along the downstream of Mahiga River. One hundred households were interviewed from each site using non-probability sampling. Results showed a higher prevalence of asthma and diarrhea among children below 18 years old in Inayawan with 23.86% and 19.65% than in Mahiga with 7.47% and 12.66%, respectively. Dengue cases were low in both sites with only 2.1% in Inayawan and 1.3% in Mahiga. About half of asthma and three-fourths of diarrheal cases in the study sites were only treated at home without medical advice. Educating these communities is of prime importance to facilitate treatment or even prevent these diseases from affecting their children.

KEYWORDS: *Pollution, children's health and urbanization*

1 INTRODUCTION

Population increase leads to development and Population increase leads to development and urbanization. Subsequently, it brings about economic gains, which change human lifestyles. On the other hand, the lack of proper urban planning development results in slum communities, which often lack access to basic services (Cabral 2016). With more and more people living in urban areas, households, commercial establishments, and industries (Nnaji 2014) produce huge volumes of refuse materials, particularly solid waste and effluents. These waste materials, if not handled properly, can threaten human health and the environment (EHS-DOH, UP-CPH & IDRC 2001; Alam & Ahmade 2013). In addition, vehicles and other industries also produce dust and noxious gases. Zirba, Haregu, and Mber (2016) reported that industries commonly dump wastewater into rivers, and without sufficient treatment prior to release contaminants at higher concentrations will be transported to the environment. The high volume and complexity of solid wastes and other environmental discharges have posed great danger to human health (Puri, Kumar, & Johal 2008; Karout & Altuwaijri 2012; Zirba, Haregu, & Mberu, 2016) especially to children below 5 years old whose immune systems are still weak (Suk et al. 2003; Webb et al. 2016).

Although economic advancements were able to combat and control conventional diseases, ailments like asthma (Suk et al. 2003, Dharmage et al. 2019) dengue, malaria, and other fever (Puri, Kumar, & Johal 2008), and diarrhea (Karout & Altuwaijri 2012) among other diseases have also evolved. Asthma is a chronic and recurring respiratory condition characterized by coughing, breathlessness, and wheezing (WHO 2017a). It is associated with allergy or hypersensitivity (Bonthapally 2010). It is still a common ailment in low- and middle-income countries (Dharmage et al. 2019). On the other hand, dengue is a vector-borne disease carried by *Aedes mosquitoes.* This disease commonly affects children although recently it has been affecting many adults too (Sam et al. 2013). It has been considered one of the primary causes of morbidity and mortality among children in Thailand and Indonesia (Capending et al. 2013). It is also considered the 9th leading cause of morbidity in the Philippines with 53,750 cases in 2013 (PHS ___). Improper waste management has been identified as a factor of dengue outbreaks (Puri, Kumar, & Johal 2008), where empty containers are used as breeding grounds for carrier mosquitos. Moreover, diarrhea is an increased frequency of stool movement in a day often caused by parasitic, viral, or bacterial infections (WHO 2017b). It is a disease associated with

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poor sanitation (Boadi & Kuitunen 2005, Otsuka et al. 2019). It has been identified as a major cause of disease and death worldwide in children below 5 years old (Lamberti, Fischer-Walker, & Black 2012; WHO 2017b, Ugwu et al. 2017).

Waste exposure, which may result in infection, can be through direct body contact, injury, inhalation, or ingestion (Zirba, Haregu, & Mberu 2016). Freitas, et al. 2010 showed that the impact of airborne pollution on asthma is higher in children at 4.4% compared to adults at 3.9%. Recently, prevalence of asthma symptoms has increased in children and adolescents especially those living in urban areas (Ferrante & La Grutta 2018). On the other hand, it has also been reported that storing waste in open containers and plastic bags at home commonly attracts flies in the kitchen was correlated with the incidence of childhood diarrhea (Karout & Altuwaijri 2012). Moreover, Ziraba, Haregu, and Mberu (2016) reported that health impacts from waste exposure could result in severe morbidity, disability, or even death.

Although these diseases are commonly reported to affect poor households, studies focusing on children particularly in slum communities in leading cities in the Philippines are limited. This paper intends to report the prevalence of asthma, dengue, and diarrhea affecting children in slum communities in Cebu City as attributed to poor environmental conditions and improper waste management in the household.

2 MATERIALS AND METHODS

2.1. Study Areas

2.1.1. Inayawan Landfill Environs (ILE). Inayawan Landfill Environs (ILE) is located at E 594910 and N 1135246 using Universal Transverse Mercator (UTM). It is situated in barangay (village) Inayawan - one of the 80 villages in Cebu City. It is where the landfill of Cebu City was constructed in 1998 (Buagas et al. 2015). However, because its capacity was already full, the facility was closed in 2012 (Ancog, Archival, & Rebancos 2012). While the Cebu City government is throwing its municipal solid waste into another landfill, the city still uses the area as a transfer station. The bulk if not all respondents of the area are squatting within 200 meters from the landfill area and are mostly engaged in the collection of recyclable materials in the transfer station.

2.1.2. Mahiga River Environs (MRE). Mahiga River is one of the river systems in Cebu City. Its tributaries are located in Apas, Cebu City. The river is about 6km long and exits at the port area in Mabolo, Cebu City. Due to residential areas built along its route, this river has become polluted. A recent study on river sediments showed that Mahiga River is highly polluted with Cu, Pb, and Zn, although all levels are still below toxicity (Vasquez 2017). The respondents are living along its downstream portion near one of the big malls in Cebu City. Specifically, the survey site was located at UTM E 600615 and N 1140334.

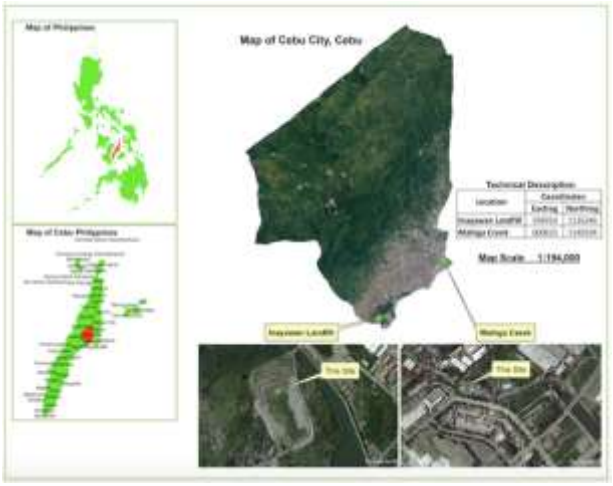

Figure 1. Map of Cebu City showing Inayawan and Mahiga.

2.2. Number of Respondents

The study used a non-probability sampling technique because the researchers do not have the knowledge on the actual number of households living within the study sites that are about 50m from the Mahiga river and within 200m distance from the Inayawan landfill. A total of 100 households were randomly interviewed at each site. Either parent or an older member of the household was chosen as the primary respondent of the interview. A household without a child aged below 18 years was automatically excluded. Prior to the actual survey, permission was obtained from each barangay at their respective barangay hall. The purpose of the survey was explained both to barangay officials around during the courtesy call and to the household before the interview. Households that did not permit the interview were respected then the members of the survey team proceeded to another household.

2.3. Collection and Analysis of Data

Data were collected using an interview schedule. The questions are in English but were asked in the vernacular and answers were translated back into English. Questions were grouped into two clusters namely household profile (household size, number of children below 18, household income, sources of water, the presence of comfort room, and means of waste disposal) and diseases of children aged below 18. The focus age group of the study is based on Iskandar et al. (2012). For cases of asthma, the inquiry was simplified based on the definition of the disease by the World Health Organization such that the child experienced coughing, difficulty in breathing, and wheezing. Moreover, actual observations on solid waste disposal, breeding sites of mosquitoes, the presence of flies in the households, and

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the smell in the immediate environment were noted.

Prevalence of targeted diseases was expressed as a percentage of the total numbers of children below 18 years based on the 100 households in each area. Chi-Square was used to analyze if the number of cases of the diseases is significantly associated with selected environmental conditions and health practices in the households.

2.4. Limitations of the Study

The study is limited only to the cases that were disclosed by respondents during the survey. Data covered only those cases experienced by any member of the household aging below 18 years old within the last 12 months.

3 RESULTS AND DISCUSSION

A total of 593 children below 18 years old were accounted for from the 200 household respondents in Inyawan and Mahiga. Inayawan had 285 children while Mahiga had a slightly higher number of children with 308. Average household monthly income is generally low with only P9420 (highest = 28,000; lowest = 1,000) in Mahiga and at 5.6 heads per household and P5,510/mo (highest = 12,000 and lowest at P1,000/month and at 5.4 heads per household. Specifically, most households in Inayawan earned their living as pickers of recyclable solid wastes, which are temporarily deposited in the area before its final disposal. Fifty-four percent of households in Inayawan used mineral water for drinking, 45% used water supplied by the water district and 1% used deep well water for drinking. On the other hand, most (82%) of households from Mahiga used mineral water while the remaining 18% used water provided by the water district

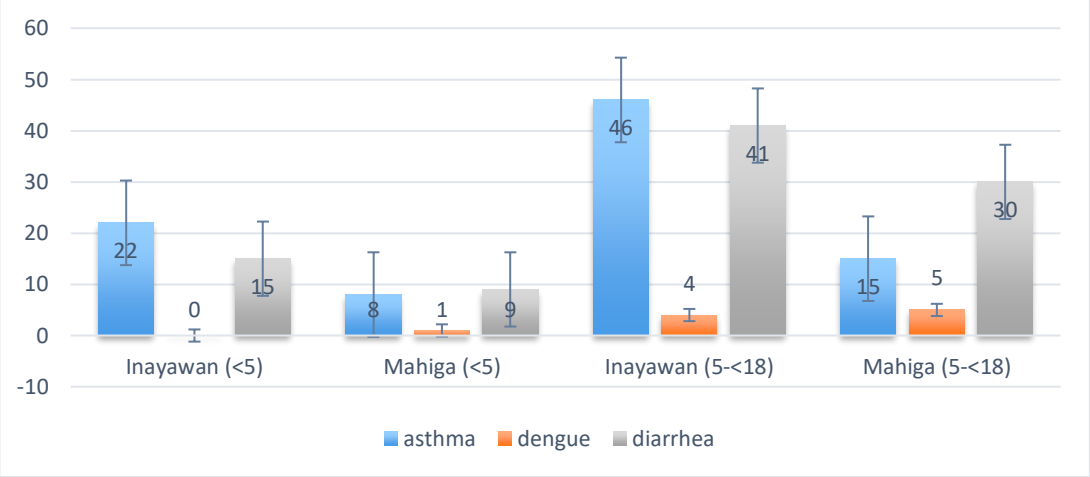

Figure 2. Profile of disease across areas and age groups

Table 1. Means of waste disposal

Means of Waste Disposal	Inayawan					Mahiga				
	Biodegradable		Non Biodegradable			Biodegradable		Non Biodegradable		
	Kitchen Waste	other biodegradable	Plastics	Metals	Glasses	Kitchen Waste	other biodegradable	Plastics	Metals	Glasses
fed to animals	24	1	-	-	-	14	-	-	-	-
thrown in garbage area outside the house	21	8	9	9	21	2	12	-	1	19
thrown in dump site	37	72	24	8	36	-	5	1	-	2
burned	12	16	16	2	3	5	2	1	2	1
sold in junkshop	-	-	50	80	38	-	-	28	48	5
thrown in river/canal	2	2	1	1	2	32	23	33	10	20
collected by gov't.	4	1	-	-	-	47	58	37	31	48
Buried	-	-	-	-	-	-	-	-	-	2
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**92**	**97**

Note: Some households claimed they have no metal or glass wastes.

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for drinking. With the presence of several deep wells in Inayawan, 45% used deep well waters for cooking and washing while the remaining 55% used water provided by the water district. In Mahiga 98% used water provided by the water district for cooking and washing and 2% used deep well water. More than half (51%) and about a quarter (24%) of households in Inayawan and Mahiga, respectively, have no toilets. Respondents in Inayawan defecate in vacant spaces surrounding the landfill (Figure 2) while those in Mahiga throw their wastes in the river.

In terms of solid waste disposal, Inayawan respondents prefer to throw their kitchen and other biodegradable wastes in the dumpsite or in an open space outside their houses and then burn them, while in Mahiga, kitchen and other biodegradable wastes are kept and collected by the local government although some just throw them outside their houses. It was also observed that people along Mahiga automatically throw their wastes in the river after eating (Table 1). Finally, most (95%) of the households across the study areas live in shanties.

3.1. Prevalence of Asthma, Dengue, and Diarrhea

Almost a quarter (23.86%) of children in Inayawan (n=68) and 7.47% of children in Mahiga (n=23) had asthma in the last 12 months. Notably, 32.35% (n=22) of children with asthma in Inayawan was 5 years old and below. Similarly, 34.78% (n=8) of children in Mahiga had asthma. In terms of sex, 63.24% of the cases in Inayawan were affecting females while an opposite scenario was shown in Mahiga with 60.87% of the cases affecting males. On the other hand, dengue had the lowest cases among the diseases covered in this study with only 2.1% or only 6 out of 285 children in Inayawan and 1.3% or 4 out of 308 children in Mahiga. All cases in Mahiga were affecting children 5-17 years of age while in Inayawan 16.67% (n=1) was affecting a child 4 years and under and the remaining 83.33% (n=5) affected children 5-17 years old. As to sex, the disease affected 3 males and 1 female in Mahiga while 2 males and 4 females were affected in Inayawan. All dengue cases were diagnosed by physicians. Finally, diarrhea was affecting almost 1 out of 5 or 19.65% (n=56) of the children in Inayawan and 12.66% (n=39) of the children in Mahiga. One out of 4 or 26.79% (n=15) of the cases of diarrhea is affecting children below 5 years old in Inayawan. Similarly, 23.08% (n=9) of the cases in Mahiga are also affecting the same age group. In terms of sex, data do not vary significantly between the two areas with 48.21% (n=27) cases affecting males and 51.79% (n=29) cases affecting females in Inayawan and 48.72% (n=19) cases affecting males and 51.28% (n=20) cases affecting females in Mahiga. Moreover, the majority of diarrheal cases in the two areas i.e. 75% in Inayawan and 74.36% in Mahiga were not checked-up by medical doctors.

The opposing proportion of asthma cases between sexes in Inayawan and Mahiga may just be incidental since none of the studies have mentioned separate cases of asthma in male and female children (Jalaludin et al. 2008; Gerez et al. 2010; Iskandar et al. 2011; Krmpotic et al. 2011; Stoner et al. 2013; Kosai et al. 2015) Moreover, parents of 58.82% of asthma cases in Inayawan and 43.48% of asthma cases in Mahiga did not seek medical advice, which indicate high preference on home remedies or home-based treatments probably because the ailment is not serious. Using a chi-square test, the prevalence of asthma was found not associated with the presence or absence of bad smell in the household environment at p=0.05.

The prevalence of asthma particularly in Inayawan is way above the national figure for the Philippines as reported by (Gerez, et al., 2010) at only 8.6% and later by (Tacio, 2016) at 12%. The increasing incidence has been explained by (Gerez, 2010) as due urbanization. It is suspected that the low income coupled by the deteriorating environmental conditions like dust and pollution (Naunton 1989; Stoner, Anderson, & Buckley 2013) especially in Inayawan due to its proximity to the landfill aggravated the higher prevalence of asthma relative to its prevalence in Mahiga. Moreover, odor in air is more severe within 500m radius from the landfill than at farther distance (Njoko et al. 2019). In a survey conducted by Kar & Basunia (2020) stomach problems and asthma were among the chronic ailments experienced by residents near landfill areas. Contrastingly, Kret et al. (2018) reported no significant differences on the prevalence of asthma with distance from the landfill. Both studies of Kar & Basunia (2020) and Kret et al. (2018) did not categorize their cases as children or adults.

As to the cases of dengue, the data yielded in the study are relatively lower than a four-year average number of cases in Rachaburi, Thailand at 3.6% (Sabchareon et al. 2012), in an ASEAN study involving five nations at 9.1% (Capending et al. 2013), and in a recent study in one of the villages in Cebu City at 8.63% (Alera et al. 2016). The latter study, however, was closely monitoring their subjects throughout the period and indicated that only three patients were admitted, unlike the present, which interviewed the households, usually parents, on cases in the last 12 months. The other implication of the low incidence of dengue compared with asthma and diarrhea both in Inayawan and Mahiga is that the disease does generally relate to pollution as earlier but can be aggravated by improper waste management (Puri, Kumar, & Johal 2008) in cases when plastic wastes and cans, for example, collect rainwater where the carrier mosquitoes breed. Edillo, Sarcos, & Sayson (2015) found out that rainfall is a significant predictor of dengue outbreaks.

As for diarrhea, while cases have been decreasing in the past years due to environmental sanitation, nutrition and exclusive breastfeeding (Baltazar et al.,

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2002) the prevalence of the disease especially in Inayawan remains high at 19.65% of children below 18 years with 26.67% of the cases are in children younger than 5 years old. This is possibly attributed by the higher number of households (45%) in Inayawan, which use the water provided by a water district as against 18% of households in Mahiga. Moreover, the absence of comfort rooms by 51% of households against 24% in Mahiga could be a strong factor why diarrhea cases in Inayawan are much higher, where people just defecate in any open space. The situation depicts that the chance of contaminated food or unclean hands, which carries the bacteria such as *E. coli* and *Salmonella sp*. is high since these bacteria are commonly found in human feces or contaminated water. Moreover, poor food hygiene, clean drinking water and lack of proper sanitation are can cause an increased prevalence of diarrhea (Ugwu et al. 2017). Although the study did not ask for any mortality relative to diarrhea, the result seems to be alarming as it is too high compared to the national figure based on 2013 statistics with 74,876 cases of acute diarrhea out of the Philippines' total population of 98,011,951 or barely 0.8% (PHS ___). The national statistics, however, included cases across age groups covered only those that are officially recorded by barangay (village) health workers (BHW) and health centers throughout the country. Based on this study with only about a quarter of cases being checked-up by doctors, the national figure can be possibly increased four-folds. The reasons why parents prefer home treatment appear to be due to financial difficulty and because they feel that the ailment can be controlled by administering natural concoctions or by administering oral rehydration medications, which can be purchased over the counter in pharmacies. This situation appears to confirm reports that slum communities have less access to basic services, especially health (EHS-DOH, UP-CPH & IDRC 2001). Chi-square test shows that cases of diarrhea were not significant with the presence or absence of comfort rooms, presence or absence of flies in the households, and washing of hands before eating at p=0.05, which suggest that diarrheal cases in Inayawan and Mahiga may be caused by other factors such as contaminated food.

4 CONCLUSION AND RECOMMENDATIONS

Asthma and diarrhea cases in slum communities in Cebu City particularly in Inayawan and Mahiga are high compared with the national figures reported by the Philippines Department of Health probably due to deteriorating environmental conditions. About half of asthma and about three-fourths of diarrhea cases did not seek medical advice possibly due to financial difficulties. Dengue cases were generally low and comparable or even lower than figures from other areas. It appears that the disease is not aggravated by environmental degradation but by changing weather conditions, especially during rainy seasons when outbreaks happen both in rural and urban areas. Proper education among residents in these communities are important to raise awareness to combat more infections in the future. Regular monitoring by personnel from the Department of Health in collaboration with the local government is likewise necessary to facilitate diagnosis and treatment of these diseases.

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