



Epidemiology and Determinants of Soil-transmitted Helminthiases among Selected Primary School Children in Tuguegarao City, Cagayan, Philippines: A Cross-sectional Study

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Abstract— Soil-transmitted Helminth (STH) infections are one of the top causes of morbidity among primary school children. This study was aimed to assess the prevalence, infection rate, and determinants of STH infection among primary school children aged 7-10 years old in Barangay Balzain, Tuguegarao City. Thirty-two Grade 1 and 2 pupils from Balzain East Elementary School were selected through purposive random sampling. Direct fecal smear testing of stool samples elucidated the prevalence of ascariasis and trichuriasis in primary school children. Data such as socio-demographic, water source, environmental sanitation, personal hygiene and health status were collected to better understand the correlation of these factors with STH infection. STH infection was found to be more prevalent [25% (95% CI: 6.02-43.98)] than Grade 1 pupils [16.67% (95% CI: -4.42-37.76)]. The relative prevalence rate was 21.88% (95% CI: 7.56-36.20), which has a qualitative interpretation of a good environmental sanitation behavior. Number of siblings was positively correlated ($p < 0.05$) with STH infection. Through a multiple logistic regression analysis, it was found out that a family with one additional child increases the probability of STH infection by about a factor of 4.2192 ($p < 0.05$). All of these findings indicate further that a good sanitation is associated with a reduced risk of transmission of STH to primary school children. Identifying factors that contribute to the dynamics of STH transmission in vulnerable groups can help to plan for effective prevention strategies.

Keywords— Soil-transmitted Helminthiases, Environmental Sanitation, School Children, personal hygiene.

I. INTRODUCTION

Soil-transmitted helminthiases are among the most common infections worldwide, and the global disease burden caused by common STHs, such as *Ascaris lumbricoides*, *Trichuris trichiura*, and Hookworm, is estimated to be about 39 million disability-adjusted life years (DALY) (WHO, 2002), which pose a serious concern. According to WHO (2013), 24% of the world's population or roughly 1.5 billion people worldwide are infected with STH infections. The WHO (2003) also noted

that such infections affect the poorest and the most deprived communities, especially the communities of the tropical region.

A lot of factors are deemed to be contributory in the prevalence of such infection, and these factors are said to be predominant in tropical countries (WHO, 2003). The Philippines is one of the countries at risk of having a high prevalence of STH infection. One of the possible reasons that can be attributed to such is that a lot of areas in the Philippines are prone to flooding. Also, it has been known

that STH infection is a risk brought about by flooding vis-à-vis poor sanitation (Yodmani *et al.*, 1982). Primary school children living in such environment are especially vulnerable to STH infections, such as Ascariasis and Trichuriasis, since the agents of the latter infections are said to have increased activity in potentially infective environment and lack of appropriate sanitary behavior (Lander *et al.*, 2012).

Socio-economic, behavioral, and environmental factors are always a part of the health system. These factors directly or indirectly affect the infestation of STH. In the same way, the prevalence of STH infection can also become a key determinant of a country's health and hygiene status (Mukherjee *et al.*, 2013).

In this study, the researchers hoped to generate an idea about the prevalence and infection rates of STH infection among primary school children of Barangay Balzain, Tuguegarao City, as well as to correlate this with the socio-economic variables that could precipitate the process or spread of STH infection.

II. METHODOLOGY

This is a descriptive cross-sectional study that dealt on determining the prevalence of soil-transmitted helminth infection among the primary school children of Barangay Balzain, Tuguegarao City, and on finding the determinants of the prevalence of STH infection. A total of 32 respondents were included in this study through purposive sampling technique. The respondents were all from Barangay Balzain, Tuguegarao City, and were all studying at Balzain East Elementary School. Out of the 32 selected pupils, 12 pupils were in Grade I Level, while 20 pupils were in Grade II Level. The researchers used descriptive survey methods in gathering the data regarding the pupil's profile.

This study was approved by the review panels of School of Health Sciences of St. Paul University Philippines, Tuguegarao City, Cagayan, Philippines. Also, prior to the conduct of the study, permission was obtained from the head of school division and school principal of Balzain East Elementary School in Tuguegarao City concerning the conduct of interviews and health education to the pupils. Upon approval, health education to the students was conducted. Informed consent was obtained prior to the conduct of the interview and sample collection. The questionnaires were then distributed to the respondents and retrieved after. This was followed by the interview of the school children and their parents. After the interview, fecal sampling was done.

A semi-structured questionnaire was used to collect information on the demographic, socioeconomic and environmental background, personal hygiene and practices as well as health status of the school children under study. Both parents and the pupils were interviewed to ensure complete gathering of information. The interviews included personal hygiene of the children and house cleanliness, availability and usage of toilets, water source, wearing shoes/slippers when outside the house, and hand hygiene behavior.

The collection of fecal samples was done according to the procedures in the Philippine Textbook of Medical Parasitology (2nd Edition). Prior stool collection, a specimen container was provided to each pupil. The pupils together with their parents were taught how to do the proper fecal sampling. Each specimen container was labeled with the name of the pupil. After specimen collection, the fecal samples were brought to St. Paul University Philippines Microscopy Laboratory for microscopic examination. Direct fecal smear technique was used for observation and identification of STH eggs. Presence of STH eggs was identified and verified with the assistance of parasitology experts.

Descriptive statistical tools (frequency, cumulative frequency, and percentages) were used to characterize the study population. Pearson's Correlation Coefficient was used to test the associations of the prevalence of STH infection with demographic, socio-economic, environmental, and behavioral factors. The level of significance of 0.05 was used for all the statistical tests. The variables that showed association with $p\text{-value} \leq 0.20$ in the univariate analysis were used to develop a multivariate logistic regression model.

III. RESULTS AND DISCUSSION

3.1 Prevalence and Infection Rate of Soil-transmitted Helminthiases

The prevalence of soil-transmitted helminth infection for Grade levels 1 and 2 pupils is shown in Table 1. A total of 7 pupils were infected with soil-transmitted helminths. Grade 2 pupils have a higher prevalence rate of STH infection with 25.00% (95% CI: 6.02-43.98) compared to that of the Grade 1 pupils with a rate of 16.67% (95% CI: -4.42-37.76). The relative prevalence rate of STH infection among the selected primary school children is 21.88% (95% CI: 7.56-36.20). This prevalence rate has a qualitative interpretation of "good" sanitation status. This is despite the fact that Barangay Balzain is a flood-prone barangay.

Table 1. The Frequency Distribution and Prevalence Rate of Soil-Transmitted Helminth (STH) infections among children in Balzain East Elementary School.

Parameter (Grade level)	Total number of subjects (N)	Number of infected subjects	Prevalence Rate (95% Confidence interval)
I	12	2	16.67% (-4.42,37.76)
II	20	5	25.00% (6.02,43.98)
Total	32	7	21.88% (7.56,36.20)

Table 2. The Infection Rate of Soil-Transmitted Helminths among Primary School Children of Balzain East Elementary School, Tuguegarao City.

Parasite	Number of Parasite (N=32)	Infection Rate (%)
<i>Ascaris lumbricoides</i>	6	18.75
<i>Trichuris trichiura</i>	1	3.13
Hookworm	0	0

In this study, *Ascaris lumbricoides* and *Trichuris trichiura* were observed to be present in the stool samples [Table 2]. *Ascaris lumbricoides* has a higher infection rate (18.75%) than *Trichuris trichiura* (3.13%). The preponderance of ascariasis is supported by the literature authored by Bethony et al (2006), in which he stated that ascariasis is the most prevalent (25%) helminthiasis worldwide. Also, it is the most prevalent STH infection in children of tropical and developing countries, and in regions where hygiene is poor (Werkman et al., 2020).

In this present study, there were no hookworms found in the stool samples examined. This finding is unusual because in other parts of the world, ascariasis and hookworm infection are more common than trichuriasis (Anuar, Salleh, and Moktar, 2014). This finding may be attributed to the age range (Ages 7 to 10) of the study population and may also be due to the potential resistance of *T. trichiura* to most of antihelminthic drugs (Anuar, Salleh, and Moktar, 2014).

The absence of hookworm infection in this study may be due to the fact that the study population was, on the

average, younger in age (Belyhun et al., 2010). According to Haldeman and his group (2020), hookworm infection has a higher rate among adults. Also, based on the survey and interviews conducted by the present researchers, it was noted that only a few parents had occupations that are in line with agriculture. In fact, in this study, majority of the primary caretakers of the primary school children were businessmen (28%). This factor could have affected the presence of hookworm infection since a higher prevalence rate of hookworm infection is seen in family heads whose occupation is in line with agriculture (Alemu et al., 2011)

3.2 Determinants of Soil-transmitted Helminthiasis

Among the categorical variables, only one variable showed significant correlation with the prevalence of STH infection. The number of siblings had a marked positive correlation with the prevalence of STH infections. All other factors had a negligible correlation.

The result of multiple logistic regression analysis of STH infection and number of siblings revealed that a family with one additional sibling increases the probability of being infected by about a factor of 4.2192. This implies further that in every one child increase in the family, the odds of STH infection increase approximately 4 times. This finding coincides with the results of several studies. In the study of Zang et al (2013), both poverty and the number of siblings were found to be significantly and positively correlated with STH infections as well as reinfections, and that a family with one additional sibling increases the probability of being infected by about 8%. In the study of Nasr et al (2013), it was reported that a large family size (tantamount to more children) is a key factor that is significantly associated with STH infection among children.

Nasr et al (2013) also reported that large families were at higher odds of ascariasis compared to children from smaller families. This finding is parallel to the results obtained by the present researchers, that is, a higher prevalence rate of ascariasis was observed in this study. This may be attributed to a possible presence of infection among other family members as well as to the horizontal spread or the focal transmission of infection among family members in the vicinity of the home (Nasr et al., 2013). Moreover, increased number of household members and overcrowded conditions are associated with a higher frequency of parasitic infections (Ostan et al., 2007; Maia et al., 2009). The results of the present study concur with these findings.

IV. CONCLUSION

Despite a number of limitations, the result of this study significantly revealed that a good sanitation and smaller

family size were associated with a reduced risk of transmission of STH infection to humans. Therefore, access to improved sanitation as well as health education should be prioritized alongside preventive chemotherapy to achieve a durable reduction of the burden of STH infections.

V. RECOMMENDATIONS

The procedural method used in this study for the stool examination was direct fecal smear. For future researchers, it is recommended that methods with higher accuracy, such as Kato Katz technique, be utilized. Also, it is recommended that the sample size be increased in order to achieve a lower margin of error. We also recommend to compare the prevalence of STH infection between a flood-prone area and a non-flood-prone area.

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