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Call to Action: Prevalence of soil-transmitted helminth infection (STHI) in Bucac, Bayugan City, Agusan Del Sur, Philippines

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Abstract

Soil-transmitted helminth infection (STHI) is among the neglected tropical diseases that presents a global problem. In the Philippines, this was reported to be spatially variable. We conducted this study to determine the prevalence rate of STHI in Bucac, Bayugan City, Agusan del Sur, Philippines and analyze the relationship of the infection with the volunteer participants' socio-demographic profile, lifestyle, and notable practices. Fecal samples were collected from 65 volunteer participants and examined by direct wet mount microscopy technique. Results revealed two helminth species, *Ascaris lumbicoides* and hookworm present in 17 fecal samples with an overall prevalence of 26.16%. *A. lumbicoides* showed a prevalence of 21.54% and hookworm infections were 4.62%. Based on WHO guideline, annual medical treatment (deworming) solution should be sustained (or started) in this part of the country. Reinforcing this solution with updated health and hygiene education campaign, particularly on WASH (Water, Sanitation, and Hygiene) strategies is also highly recommended. Chi-square analysis showed no significant relationship between the helminth infections and the variables considered in the study (gender, age, occupation, type of toilet, source of water for bathing, washing, drinking, presence of domesticated animals and wearing of footwear). Regardless of the different variables included, ascariasis and hookworm infections are still present around Barangay Bucac, Bayugan City, Agusan Del Sur and poses a public health concern. Implementation of ways to control or eradicate the present infections as well as further assessment and monitoring (with consideration of the economic status) in the area is recommended.

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Introduction

Helminthiasis is one of the neglected diseases in the world that remain a public health concern for decades (Blyther, 2011). This infection was globally distributed with *Ascaris lumbricoides* showing the widest distribution among a certain group of soil-transmitted helminth species (Pullan *et al.*, 2014). By using the model-based geostatistical predictive methods, Soares Magalhães *et al.* (2015) found out that STH infection prevalence in the Philippines is spatially variable.

Poor sanitation and lack of knowledge in proper hygiene among individuals in low-economic status are some of the possible causes of high STH infections (Uzodimma *et al.*, 2016) which can lead to long-term yet subtle health effects and morbidity (Campbell *et al.*, 2016). Although there have been health programs to educate and treat people for the control and elimination of the disease burden especially in developing countries (Al-Delaimy *et al.,* 2014), there are still studies that obtained results on significant STH infection and re-infection in endemic regions (Zerdo *et al.*, 2016; Rujeni *et al.*, 2017).

In the Philippines, a study conducted using STH predictive maps showed high endemicity of at least one of STH, which necessitates national attention for control (Soares Magalhães *et al.*, 2015). This has supported the earlier baseline prevalence results in Luzon, Visayas, and Mindanao conducted by Belizario *et al.* (2005). Nevertheless, planning for control interventions and programs would need fresh or reliable data on the prevalence and degree of STH infection (Kaminsky *et al.*, 2014) for this would support design of integrated disease control strategies (Kinung'hi *et al.*, 2014). In fact, the World Health Organization (2012) recommends taking prior surveys before executing any form of deworming treatment or control programs. In addition to that, being one of the third world countries, the Philippines needs to be aware about the highest incidents of infection to properly allocate limited supplies for STHI control methods (Soares Magalhães *et al.*, 2015). This study was conducted to determine the prevalence of STH infection in Bucac, Bayugan, Agusan Del Sur, Philippines.

The sociodemographic data, lifestyle, and notable practices were also gathered and correlated with the infected volunteer participants. The data obtained can be used as a basis for the need to conduct STHI control and treatment programs as well as health awareness and education campaigns in that specific area of the country.

Materials and methods

Study Area

Bucac is one of the many barangays in the city of Bayugan, Agusan del Sur, Philippines. Located specifically in Caraga region in Mindanao, it belonged to the type II climate category characterized by no dry season with very pronounced wet season of heavy precipitation (Lantican, 2001). It is part of the central provinces of Mindanao that was predicted to have 20 - 40% prevalence rate of hookworm infection in a particular risk mapping study conducted by the team of Soares Magalhães (2015).

Data Collection

The importance of ethical approval from the authorities of the barangay and the participants was never missed before conducting this study. Volunteer participants were orientated about the proper sampling procedures and its significance. Forms and questionnaires were distributed to obtain socio-demographic information along with the data on the participants' way of life and/or significant practices (Punsawad *et al.*, 2017).

Sampling and Data Analysis

Fecal samples were collected and checked using the direct wet mount microscopic technique to detect helminth eggs (Gashout *et al.*, 2017). The rate of prevalence was determined using the standard formula and the results were analyzed (Chi-square Test) in relation to the participants' socio-demographic data, lifestyle, and other notable practices through Paleontological Statistics Software (PAST) (Belizario *et al.*, 2011).

Results

Prevalence of Soil-Transmitted Helminth Infection and Associated Sociodemographic Data

The major species of STH include the roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and Hookworms (*Ancylostoma duodenale* and *Necator americanus*) that cause clinical infection to humans (WHO, 2012; Brooker, 2006).

Among the 65 stool samples examined using the wet mount technique, 17 were positive with Helminth ova (26.16%) (Table 1). *A. lumbricoides* (21.54%) and Hookworm species (4.62%) were detected. Other Helminth species were not observed.

Table 1. Frequency and prevalence of soil-transmitted helminths in Bucac, Bayugan City, Agusandel Sur.

Helminths	Frequency	Prevalence Rate (%)
Ascaris lumbricoides	14	21.54
Hookworm	3	4.62
Total	17	26.16

Table 2 shows the sociodemographic data and the distribution of STH infection among the infected participants. Apparently, the stool exam showed a higher prevalence rate of *A. lumbricoides* in male participants (57.14%) than female participants (33.33%). However, there is a higher prevalence in females (66.67%) as compared to males in terms of hookworm infection (42.86%).

Table 2. Frequency and prevalence of *A. lumbricoides* and hookworm between gender, age groups, and occupation among the volunteer participants in Bucac, Bayugan City, Agusan del Sur.

	Ascaris lumbricoides		Hookworm	
	Frequency	Prevalence (%)	Frequency	Prevalence (%)
Gender				
Male	8	57.14	1	33.33
Female	6	42.86	2	66.67
Age(years)				
1-9	5	35.71	1	33.33
10-18	3	21.43	0	0.00
19-27	1	7.14	0	0.00
28-36	1	7.14	2	66.67
37-45	2	14.29	0	0.00
46 and above	2	14.29	0	0.00
Occupation				
Farmer	2	14.29	0	0.00
Housewife	2	14.29	2	66.67
Preschool and schooling	8	57.14	1	33.33
Construction worker	1	7.14	0	0.00
Storeowner	1	7.14	0	0.00

Soil-transmitted helminth Infection can be prevalent in both adults and children (Anderson *et al.*, 2015; Bopda *et al.*, 2016). The infected participants in this study aging 1-9 years old showed the greatest *A. lumbricoides* prevalence rate of 35.71% and followed by the 10-18 age bracket which was 21.43%. The lowest rate, however, belonged to the 19-36 years old participants (7.14%). On the other hand, hookworms were highest in 28-36 years (66.67%) while no hookworm eggs were detected in 10-27 years old bracket as well as 37 years and above participants.

Occupation is one of the risk variables of soil-transmitted helminth infection (Fuhrimann *et al.*, 2016; Ross, *et al.* 2017). The result revealed highest prevalence rate of *A. lumbricoides* among preschool and schooling groups while the same group obtained the second rank in terms of hookworm infection (33.33%). Farmers and housewives obtained 14.29% prevalence rate for *A. lumbricoides*.

Housing and Lifestyle Practices Associated with Soil-Transmitted Helminth Infection

Things associated with housing and lifestyle (Table 3) are potential risk factors for STH infection (Belyhun *et al.*, 2010). *Ascaris lumbricoides* (85.71%) and hookworm species (14.29%) infection were found out to be both higher in those participants with dry pit latrine than in the water-sealed, ceramic toilet. Volunteer participants who are using artesian well as a source of water for bathing, washing, and drinking also are more prevalent with ascaris infection (92.86%, 85.71%, and 71.43% respectively). However, the water district source obtained a greater prevalence rate (14.29%) of hookworm in participants who are using it for washing and drinking. Artesian well used for bathing remained to be higher (66.67%) with regards to the hookworm species.

The result on the prevalence of STH infection and its association to life practices which includes the presence of domesticated animals and wearing of footwear is depicted in Table 4. Households that have domesticated animals undoubtedly revealed higher prevalence rate of STH infection for both *A. lumbricoides* (71.43%) and Hookworms (100.00%). However, despite regular wearing of footwear, STH infection of *A. lumbricoides* (100.00%) and hookworm species (100%) are still evident.

Table 3. Frequency and prevalence of *A. lumbricoides* and hookworm in relation with the type of toilet and source of water among the respondents in Bucac, Bayugan City, Agusan del Sur.

	Ascaris lumbricoides		Hookworm	
	Frequency	Prevalence (%)	Frequency	Prevalence (%)
Type of Toilet				
Pit Latrine (Dry)	12	85.71	3	100.00
Pit Latrine (*Water Sealed - Ceramic*)	2	14.29	0	0.00
Source of Water (Bathing)				
Artesian well	13	92.86	2	66.67
Deep well	1	7.14	0	0.00
Water district	0	0.00	1	33.33
Source of Water (Washing)				
Artesian well	12	85.71	1	33.33
Deep well	0	0.00	0	0.00
Water district	2	14.29	2	66.67
Source of Water (Drinking)				
Artesian Well	10	71.43	1	33.33
Water District	2	14.29	2	66.67

Table 4. Frequency and prevalence of *A. lumbricoides* and hookworm in relation to the presence of domesticated animals and wearing of footwear among the participants in Bucac, Bayugan City, Agusan del Sur.

	Ascaris lumbricoides		Hookworm	
	Frequency	Prevalence (%)	Frequency	Prevalence (%)
Presence of Domesticated Animals				
Present	10	71.43	3	100.00
Absent	4	28.57	0	0.00
Wearing of footwear				
Always	14	100.00	3	100.00

The overall result of chi-square analysis in this study revealed no significant difference (p>0.05) which could mean that the prevalence rate of STH infection is not associated with the mentioned lifestyle and common practices of the volunteer participants in Bucac, Bayugan City, Agusan Del Sur.

Discussion

The prevalence rate of soil-transmitted helminth infection (21.54% [ascaris] vs 4.63% [hookworm]) revealed in this study is similar to the results conducted by some other researchers. Studies conducted by Belizario *et al.* (2011); Sumagaysay and Emverda (2011) in Davao and Bukidnon, Philippines, showed the highest prevalence of *Ascaris lumbricoides* infections among all other helminth species.

Since the study area has a type II climate, it would not be far from possible to obtain such result for ascaris as it is suggested to favor cooler conditions in the tropical areas (Wardell *et al.*, 2017). Moreover, this is supported by the study of Gentry *et al.* (2016) across East Africa wherein the researchers found out that the risk of transmission of *A. lumbricoides* in forested tropical areas is greater than in arid or semi-arid regions which can be attributed to the nature of the species eggs to desiccate in high temperatures or reduced humidity (Brooker, 2006).

Similarly, the lower rate of prevalence of hookworm infection (4.63%) in this study can be explained based on the existing season or climate of the study area. While ascaris eggs are likely to survive in temperature not exceeding 37˚C, hookworms are observed in areas with temperature mostly exceeding 40°C (Brooker, 2002).

More males than females were infected with STH particularly *A. lumbricoides* in this study which is similar to the result conducted by Campbell *et al.* in 2016. Basically, farming as the major occupation among the participants would perhaps best explain the outcome as they can come in frequent contact with possibly contaminated soils (Fuhrimann *et al.*, 2016; Amoah *et al.*, 2017). However, just like the study of Yajima *et al.,* (2009), the result showed no significant association with gender difference and occupation of the infected participants.

High prevalence rate among children is a common result in studies about STH infections (WHO, 2011) as young ones are more prone to various intestinal parasitic attacks due to poor hygiene awareness and behaviors or habits (Assefa and Kumie, 2014). This study showed a similar result with the systematic review about helminth infections published by Wright *et al.* in 2018, stating that children are at higher risk of intestinal infections. Further, the association of *A. lumbricoides* among other intestinal parasitic infections was also positive in the study conducted by Faria *et al.* (2017).

Pit latrine is one of the most basic forms of improved sanitation facilities (UNICEF and WHO, 2008) employed around the globe particularly in developing or low-income countries (Nakagiri *et al.*, 2016).

Although this is a well-recognized method to improve human waste disposal, it may still carry great risks of groundwater contamination (Tillet, 2013), thus the possibility of any sort of intestinal parasitism. The result of this study resonates with the findings of Lawangen, *et al.*, in Tublay, Benguet (2012) where STH infection is higher in schoolchildren who use dry pit latrines. But even with such result, this study cannot strongly support the association of infection with the type of toilet and major water source (artesian well) used by the infected participants. Further data gathering and analyses are required.

Zoonotic transmission of soil-transmitted helminth infection is possible in areas or households with domesticated animals (Oyebamiji, *et al.*, 2018) but this can be reduced or prevented by using footwear that could block infective agents from penetrating the skin (Tomczyk *et al.*, 2014; Malavade, 2015). However, the data show the presence of both *A. lumbricoides* (100%) and hookworm (100%) infections despite wearing of footwear which implies that the infection could not be associated with this variable. In addition to that, Paige *et al.* (2017) stated that the types of shoes, activities, along with other factors may contribute to the efficacy of footwear as an intervention of the transmission of helminth species which were not actually included in this study.

Conclusion

Overall, our study showed that STH infections (particularly *Ascaris lumbricoides* and hookworm species) exist in Bucac, Bayugan City, Agusan del Sur, Philippines with a 26.16% prevalence rate which may signify a public health concern that calls for effective medical treatment and control. Nonetheless, our data did not show a strong association of STH infection with the socio-demographic data, lifestyle, and notable practices ($p>0.05$) indicating that there could be other factors not included in the study which contributed to the resulting prevalence of STH infection among the infected volunteer participants.

Recommendations

In line with the WHO global target to eliminate morbidity of high-risk people in endemic areas from soil-transmitted helminthiases, we suggest that the right department of the Philippine government will sustain and/or improve the implementation of annual deworming activities in this area of the country as the prevalence data show greater than 20% rate of STHI (WHO, 2017). Moreover, this should be reinforced with updated health and hygiene educational campaigns, strongly emphasizing on WASH strategies and practices which according to a number of other research sources (Becker *et al.*, 2018; Clarke *et al.*, 2018) suggest essential roles in successfully eliminating or reducing STH infections.

It might be a fact that the soil is among the main reservoirs of helminth eggs (Yawson *et al.,* 2018) but infected humans can also be the potential parasite reserves and source of dissemination of soil-transmitted helminth infections (Bopda *et al.*, 2016), thus applying the most suitable treatment solution in this community is simply a rational action. For future prevalence studies on STHI in Bucac, Bayugan City, Agusan del Sur, Philippines or elsewhere, it is noteworthy to expand the sample size and check the correlation of infection with more risk factors that would better explain the prevalence rate of infection which could serve as the basis of the implementation of control and prevention strategies.

As researchers, we are deeply involved in finding effective ways to end the global problem of STH infection. We therefore recommend that continuous STHI monitoring is intentionally carried out in endemic countries like the Philippines, to know if the implemented solutions are making progress in reaching the goals and to check for any necessary modifications (Becker, S. *et al.*, 2018; Vimal Raj *et al.*, 2018). Part of this monitoring action is to use sensitive and specific diagnostic techniques in obtaining highly accurate prevalence results that could pose a direct impact on the policies and programs recommended by the WHO (Mationg, M. *et al.,* 2018; Jourdan, P. *et al.*, 2018). Nonetheless, we also need to consider the economic status of a country, thus we recommend the practical and cost-effective techniques like the Kato-Katz as diagnostic tool when conducting further studies on the prevalence of STHI in rural areas with disadvantaged economic status (Turner, H. *et al.*, 2017).

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