

# A vicious cycle of helminth infections: Current sanitation status and practices that led to continued STH transmission in rural communities in the Philippines

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## Research Article

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# Abstract

## Background

Helminth infections among children remains a public health concern despite continued deworming activities conducted in all public schools nationwide. Access to improved sanitation facilities not only leads to continued practice of open defecation predispose children to this intestinal parasitic infection. This study aim to characterize the sanitation situation and practices among households as well as their deworming practices and associate it with the prevalence in two rural communities in San Pascual, Masbate, Philippines.

## Methods

A survey of 234 randomly selected households from the two barangays was conducted followed by stool screening using Kato-Katz method from 586 children and adolescents below 18 years old was done in June 2019.

## Results

The survey showed that 33.28% of households do not have access to sanitary toilet and open defecation was practiced by 53.92% of surveyed households. More than half of the households (60.75%) surveyed also reported "poso" as their source of drinking water. The survey also revealed that households have high scores in the knowledge, attitude, and practices or KAP section of the survey. The over-all cumulative prevalence rate was at 41.6% moderate to light intensity infection rate.

## Conclusion

Among the variables tested, only the source of drinking water, attitude scores, and MDA participation showed association with having helminth infection among children. The study highlights the importance of advocating multi-sectoral approach in addressing persistent public health issues like the intestinal parasitic infections among children. Moreover, this study provides valuable information needed to support strategies like community-led total sanitation or CLTS as a potential strategy addressing both sanitation and public health dilemma.

# Introduction

Soil-transmitted helminth or STH infection is considered as a significant public health concern in developing countries like the Philippines which have poor access to sanitation facilities (31%) and no access to improved water sources (8%) (WHO/UNICEF, 2012). Open defecation (OD) practice predisposes millions of people globally to STH and other intestinal parasitic diseases. OD practice can even affect 1.8 billion people who accessed drinking water that is contaminated with fecal parasites (WHO/UNICEF, 2017). A study conducted in Kenya showed that there was a higher diarrheal prevalence rate in regions where OD is reported (Njuguna, 2016). Moreover, deaths of children under five due to unsafe sanitation brings a toll of 361,000 worldwide annually (Prüss-Ustün, et al, 2014). In the Philippines, 4.5% of households practice open defecation (PSA & ICF, 2018).

While addressing the OD practice dilemma is done by providing hardware (toilet/latrine and sewage system) and software (practices and policies) (Albonico, Montresor, Crompton & Savioli, 2006) components to the target areas, addressing the STH infection among children is done at schools nationwide. In the Philippines, the primary strategy for controlling the spread of these parasitic infections is by mass administration of anti-parasitic drugs (Albendazole/Mebendazole) among school-aged children. This approach serves as both preventive and treatment measure in lowering the incidence of STH infection among children. The problem with this is that reinfection is likely to happen once mass treatment is skipped or not sustained (Clements, et al, 2009; Doenhoff, Cioli, & Utzinger, 2009; Ross, et al, 2002). In 2015, a study in Southern Leyte revealed that persistence of OD practice has led to similar continued transmission of STH among preschool aged and school aged children (Belizario et al. 2015). Since the focus of the mass drug administration of deworming drugs is on public school children, a major percentage of children remained not treated similar to the evidence found in other countries (Anderson, et al, 2013).

Achieving zero open defecation or ZOD status has been very challenging the country like the Philippines. Community-led total sanitation or CLTS was one of the strategies employed to achieve ZOD status. This participatory rural appraisal method aims to

awaken the community about their sanitation problems and make them act upon using indigenous materials (Kar and Chambers, 2008). CLTS is now implemented in 59 countries worldwide particularly in Asia, Africa, and Latin America (Zuin, et al, 2019). A case study in Malawi showed that villages that underwent CLTS activities tend to have children showing better health stature and less likely to be stunted (Pickering, et al., 2015). While it is found effective elsewhere, there is a dearth of knowledge on how strategies like the CLTS approach works in Philippine setting; and how the intervention was received by the communities. According to the case study conducted by UNICEF East Asia and Pacific Region Office or EAPRO, the performance of the country in achieving ZOD has been hampered by challenges like lack of political will, over-reliance to international donors or non-government organizations, and the geographic disadvantages of the target communities (UNICEF, 2012).

The purpose of this specific paper is to characterize the prevailing knowledge, attitudes, and practices on hygiene and sanitation practices of selected households in two STH-endemic communities in San Pascual, Masbate, Philippines and determine which among those variables contribute to the persistence of STH infection among children. This paper is part of a bigger project entitled: "Ending the transmission cycle: Community-led total sanitation as an approach for reducing STH prevalence in endemic communities in Masbate, the Philippines". This project wanted to evaluate the changes in the knowledge, attitudes and practices of households and children in hygiene and sanitation as well as their STH prevalence rate after undergoing the community-led total sanitation or CLTS process to address the interconnected problem of intestinal parasitic infection and OD practice in the Philippines.

## Methodology

Based on the 2013-15 National Prevalence Survey Report, Region V is on top of the list with highest STH prevalence rate with the Province of Masbate having 77.5% STH prevalence rate (RITM, 2015). The National Demographic and Health Survey also showed that in Region V, 7% of households practice OD (PSA & ICF, 2018). Upon review of existing documents, two (2) highly STH-endemic barangays (Laurente and Dancalan) in San Pascual, Masbate were selected as study sites. The study employed stratified cluster random sampling using households as cluster units. Households were randomly selected and all children aged 2–17 years old were asked to provide stool samples for stool assessment in June 2019. Consenting household heads were interviewed using a pilot-tested questionnaire about the type, ownership, and frequency of use of toilet facility, open defecation practices, water sources, predominant handwashing behavior of their children, including their participation in last year's deworming activities in their community. Children aged 2–17 years old in all participating households were asked to submit stool samples for intestinal parasite screening. During pre-scheduled community assemblies, participants as well as household heads were oriented by trained medical technologists (MdTs) on the purpose of the survey and proper stool collection techniques. Stool samples were submitted by the participants on scheduled days at their barangay health centers (BHC) or to assigned barangay health workers (BHW) that were hired to collect samples. All stool samples were processed using the Kato-Katz (KK) technique (Annex A) on the same day as they were received. Double blinded screening for intestinal parasites using microscopy was employed in all processed stool samples within the week. The laboratory results were given to each household and a copy was given to the municipal health officer (MHO). All children that were positive with any STH infection were prioritized in the next round of deworming activities scheduled in their communities. All data collection forms were double encoded using MS Access before data analysis was done using SPSS 16.0 (SPSS, Inc., 1989–2007). This study used chi-square test of independence to determine the association of variables with the prevalence rate. Households that were not able to provide stool samples were excluded in data analysis.

## Results

The overall stool sample submission rate was 47.83 % from all households interviewed. In the end, only 52.70% of all interviewed households were included in the analysis. The most cited reasons for non-submission of stool samples were children were reluctant to submit stool samples while some were unable to defecate in the time of the visits. The sex distribution among children who submitted stool samples were roughly equal; 50.7% male and 49.3% female. This survey revealed current sanitation status and practices in the selected study sites.

Table 1  
Summary of descriptive statistics

	Laurente	Dancalan	Combined
<i>Individual level</i>			
Total no. of HHs encoded / interviewed	108 / 223	126 / 221	234 / 444
Total no. of stool samples screened / targeted	276 / 594	310 / 631	586 / 1 225
Sex (Screened samples)			
Male	139	158	297
Female	137	152	289
MDA participation in last 12 mos. (No., %)			
Once	49	16	65, 11.09
Twice	191	279	470, 80.20
More than twice	19	3	22, 3.75
Didn't participate in past 12 mos	17	12	29, 4.95
Practicing OD			
Yes	154, 56.20	162, 52.26	316, 53.92
No	120, 43.80	148, 47.80	268, 45.73
Frequency of OD			
Frequent	85, 55.19	102, 62.96	187, 59.18
Occasional	69, 44.81	60, 37.04	129, 40.82
<i>Household level (No., %)</i>			
Toilet type ownership			
Water-sealed (w/ septic tank)	185, 67.03	180, 58.06	365, 62.29
Water-sealed (w/o septic tank) & pit latrine	15, 4.84	11, 3.99	26, 4.44
None	80, 28.99	115, 37.10	195, 33.28
Source of drinking water			
Store-bought water	38	5	43, 7.34
Community water system	76	33	109, 18.60
<i>Poso</i>			
Dug well	14	51	65, 11.09
Collected rainwater	12	1	13, 2.22

Majority of screened children (83.95%) have taken the recommended number of deworming medicine last year (twice or more). Most of them reported that they participated in the MDA conducted at their schools.

Open defecation was found to be a common practice among children. Parents were also asked about how frequent these children defecate in the open, it was found out that more than half of all children screened do it frequently. Parents explained that these children were not yet potty-trained. Others explained that their homes and temporary residences simply lacked toilets (e.g. a child studying in another town may be staying in a relative's house with no toilet facilities).

Table 1 shows that 33.28% of households that do not have a decent toilet facility. While the majority of the households (62.92%) reported that they have septic tanks for their toilets, almost half of the interviewed households do not adhere with the recommended sanitation standards. Aside from that, 27.74% of those who reported having a toilet facility were sharing it with their relatives living in close proximity to their houses.

Table 1 also describes where households obtain drinking water. The common source of drinking water in these communities was from “*poso*” or artesian pumping well, which is usually shared by several households.

Figure 2 describes the reported handwashing practices of children. Parents were asked if they observed their children wash their hands before eating, after eating, and after defecation. Majority reported that their children do wash their hands before or after these activities. Children from the younger age groups, who are still under close parental supervision, have their hands personally washed by their parents or guardians. Nearly all the parents surveyed reported soap usage in handwashing, with only a scant few from Brgy. Laurente using only water.

Figure 3 shows the results of a 5-point likert scale with 12 questions designed to measure household heads’ knowledge of STH causes, symptoms, and treatment; attitudes; and actual practices against STH infection. Responses to each statement have corresponding points that determined the KAP score for each household. All scores were categorized into three: ‘High’, ‘Average’, and ‘Low’, with a 6-point interval from the lowest possible score. Most participants in both communities scored ‘High’ on Attitude-related statements while scores on Knowledge- and Practice-related statements veered towards ‘Average’. These scores suggest that participants have relatively good knowledge about the illness and they are eager to address STH infections but fall short on actual practice. To illustrate, several parents admitted that while they forbid their children from walking or playing barefoot on soil, they are often disobeyed and cannot always supervise their children.

Table 2 below describes the cumulative prevalence of soil-transmitted helminths (STH) was 41.6% with moderate to light intensity of infection. Roundworm and whipworm infections were both considerably higher in Brgy. Laurente than Dancalan. On the other hand, Table 4 describes intensity of infection per species in the two study sites. Majority of the *Ascaris* infections were only light to moderate while *Trichuris* infections were overwhelmingly light.

Table 2  
STH prevalence rate and intensity of infection per barangay

<b>Intestinal helminth</b>	<b>Laurente (%)</b> <b>n = 276</b>	<b>Dancalan (%)</b> <b>n = 310</b>	<b>Prevalence (per specie)</b> <b>n = 586</b>
<b>Cumulative STH Prevalence</b>			<b>41.6%</b>
<b>Roundworm (Ascaris lumbricoides)</b>	102 (36.96%)	44 (14.19%)	146 ( <b>24.9%</b> )
Heavy	10 (9.80%)	1 (2.27%)	
Moderate	43 (42.16%)	20 (45.45%)	
Light	49 (48.04%)	23 (52.27%)	
<b>Whipworm (Trichuris trichiura)</b>	136 (49.28%)	26 (8.39%)	161 ( <b>27.47%</b> )
Heavy	4 (2.94%)	0	
Moderate	24 (17.64%)	1 (3.85%)	
Light	107 (78.68%)	25 (96.15%)	
<b>Hookworm (Ancylostoma duodenale and Necator americanus)</b>	0 (0%)	2 (0.65%)	2 ( <b>0.34%</b> )
Heavy	0	0	
Moderate	0	2 (100%)	
Light	0	0	
<b>Other (Heterophyids and E. Vermicularis)</b>	4 (1.25%)	4 (1.29%)	8 ( <b>1.37%</b> )

Table 3 describes the variables associated for being tested positive with STH infection among children. From all the variables, only the drinking water source, attitude scores, and participation in deworming activities were found to be related to having STH infection.

Table 3  
Summary of statistical analysis

Variable	p value at $\alpha = 0.05$
<b>Household level</b>	
Toilet type ownership	0.295
Drinking water source	0.002*
KAP Score	0.785
Knowledge Score	0.340
Attitude Score	0.022*
Practice Score	0.883
<b>Individual Level</b>	
Sex	0.118
MDA Participation in last 12 mos	0.025*
Practice of OD	0.873
Frequency of OD	0.496
Handwashing practice before meal	0.336
Handwashing practice after meal	0.955
Handwashing after defecation	0.407

## Discussion

One-third of the households surveyed still do not have access to decent toilet facilities. Lack of access to toilet facilities have been associated with the lower economic status of the households (WHO/UNICEF,2014). The two barangays belong to a 3rd class municipality with a poverty incidence rate of 57.12% (PSA, 2016). With this kind of poverty incidence rate, households are expected to prioritize other pressing household needs, compromising with water and sanitation. This might have caused the persistence of OD practice in these barangays. A study conducted in Ghana found out that one of the factors why OD practice persists were the lack of access to physical toilets, among other things (Osumanu, Kosoe, & Ategeeng, 2019).

Deworming activities at school have been both the preventive and curative intervention for STH infection. Despite being offered for free and known to be effective, achieving the target coverage rate to approximately 19.6 million children in public school alone (WHO, 2016) was daunting for the Integrated Helminth Control Program of the DoH. In this study, 95.04% of the screened samples reported that they received deworming drugs in the last 12 months, however, only 83.95% participated in the recommended number of deworming intake. This is still below the national target for MDA coverage of at least 85%, wherein positive impact on reducing the burden of the disease is expected (Department of Health, 2015). This results on MDA participation was consistent with the national status of deworming coverage. In WHO reported data, the national coverage for deworming was 75.7% (Lo, et al, 2020). But unlike in sanitation, it is not the lack of access to free and safe medication that poses a problem. It is the lack of confidence of the parents to the teachers' ability to take care of their children whenever adverse reactions to medications might occur during the deworming day (Lorenzo, Manzanilla, Cortel, & Tangog, 2019; Sinha, et al, 2011).

The KAP scores shown in this study suggest that the community is very aware of how the disease is transmitted and its symptoms, and they have a good attitude towards the disease prevention. However, they fell short on practices. Health workers played an important role in advocacy efforts on WASH and STH illness. Studies revealed that community health workers were the main source of information in these communities (Parikh, et. al., 2013; Lorenzo, et al 2019). Parents were aware that their children sometimes walk barefooted on soil especially during playtime, picking up and eating dropped foods from the bare ground, and

even nail biting. Although these practices were discouraged, disobedience and not being with their children most of the time led to continued practice.

This study also found out that *Trichuris trichiura* and *Ascaris lumbricoides* accounted for 27.47% and 24.9% of STH infections in both sites, respectively, with the majority being light intensity infections. Other surveys conducted in other provinces in the Philippines also revealed a similar trend of prominence of *T. trichiura* infection followed by *A.lumbricoides* and hookworms (Mationg, et al, 2017; Ross et al, 2017; Soares, Salamat, Leonardo, Gray, Carabin, Halton, et al. 2015). The communities with lack of access to proper water, hygiene, and sanitation facilities were usually found to have high STH prevalence rates (Pullan, et. al, 2014; Ross et al, 2017). This lack of access to sanitation facilities exacerbates the practice of OD which allows the continued risk of STH transmission (Ziegelbauer,et. al., 2012). Studies found that human excreta from STH infected individuals can contaminate soil which can be one of the modes of transmission for STH infections among school aged children (Nery, et. al., 2019). A survey on soil from farms from North and South Luzon also revealed that they harbor these intestinal parasites, and those farms that utilized manure as fertilizer have a higher rate of parasites seen in soil samples compared to those that use chemical fertilizers (Paller & Babia-Abion, 2019). This study suggested that the presence of parasites in soil only suggest unhygienic practices like open defecation.

The continued practice of OD due to lack of access to improved sanitation facilities can also contaminate water sources intestinal parasites which can be transferred to human thru contact. The most common source of drinking water in the selected communities were *poso* or artesian pumping wells, which oftentimes not treated. A study conducted in Cebu found out that improved water supply and environmental sanitation practices reduced the risk of reported diarrhea in clinics (Baltazar, Briscoe, Mesola, et al., 1988). A systematic review of 94 studies was conducted that found out that the use of treated water and piped water access reduce the risk of STH infections (Strunz, Addiss, Stocks, Ogden, Utzinger & Freeman, 2014). While STH is known to be transmitted thru soil and not water, the possibility of drinking untreated water contaminated soil harboring these intestinal parasites can pose risk and has to be explored further.

Among different approaches, CLTS was found to be popular in many countries in Asia and Africa as a low input, low cost, and community-initiated strategy to address hygiene and sanitation (Kar, 2005). While taunted to be participatory and sustainable in terms of implementation, there is very little interest in looking at its impact on public health and sanitation. In fact, there is only one study in the country that looked into the possible effects of CLTS in STH prevalence. It revealed that CLTS communities have relatively higher STH prevalence rate compared with non-CLTS communities in Southern Leyte (Belizario, et al, 2015). The main reason to explain this was the reversion to OD due to lack of monitoring after ZOD certification. This was also one of the challenges reported in East Asia coupled with lack of commitment to sustain among government agencies (UNICEF EAPRO, 2015). An archipelagic country like the Philippines presents geographic and spatial differences per region, highlights the necessity of providing improved sanitation facilities and behavior change interventions to supplement MDA for STH control and prevention (Soares, et al, 2015). Like hitting two birds in one stone, CLTS is one of the approaches that can be explored and strengthened to address not only sanitation challenges among rural communities but also public health issues like STH infections among children.

## Conclusion

The persistence of intestinal parasitic infection among school aged children was caused by a myriad of factors. Lack of access to decent toilet facilities due to socio-economic factors have led people to practice open defecation. Open defecation can contaminate drinking water sources which can lead to public health concerns if left unaddressed. Parent's lack of confidence in teachers' ability to handle and address adverse reactions to deworming drugs led to an unmet MDA coverage target.

While this study did not conclude association of OD practice and STH infection among children, it has described the sanitation and prevailing KAP in STH endemic communities like San Pascual, Masbate. This is the preliminary data for a bigger study that would want to see the effects of CLTS in decreasing the STH prevalence in target communities but also changing their hygiene and sanitation practices.

This study provided evidence to strengthen strategies that not only provide disease-specific response but also change the attitudes and practices of the target communities. While MDA is proven to be a cost-effective strategy for STH infections among school aged children, it cannot prevent reinfection unless hygiene and sanitation are improved simultaneously. There is a need to strengthen support and implementation of strategies like community-led total sanitation or CLTS can provide sustainable hardware and software solutions to hygiene and sanitation. Without the partnership and commitment of the local government agencies and its people, achieving and sustaining target MDA coverage and ZOD status will be daunting and intestinal parasitic infection among children will continue to persist. For a developing country like the Philippines, a strategy that can address two of the most persisting problems in rural communities is something that is worth exploring, and CLTS is one of them.

## **STUDY LIMITATIONS**

One of the limitations of the study was the potential biased on self-reported information and observed behavior among children. Researchers relied on probing skills of trained data collection team and sincerity of the respondents' providing the right information. Adopting alternative ways of recording accurate information on practices and behavior can provide more information between the link of intestinal parasitic infections and OD practice among children. Information about the possible effects of CLTS in improving sanitation practices and preventing transmission of STH has yet to be proved in this paper. A follow up survey was intended after one of the communities has undergone CLTS activities and has declared a ZOD community. This will prove the need of integrating strategies to address different health and sanitation outcomes. Moreover, stakeholder and community engagement are necessary to ensure that interventions like CLTS are implemented so there are opportunities to study the implementation process.

## **Declarations**

### **ETHICAL APPROVAL AND CONSENT TO PARTICIPATE**

The study was thoroughly reviewed and was given an approval by Institutional Review Board of Research Institute for Tropical Medicine in May 24, 2019.

### **CONSENT FOR PUBLICATION**

The authors consent to the publication of the manuscript to Infectious Diseases of Poverty, should the article be accepted by the Editor-in-chief upon completion of the refereeing process.

### **AVAILABILITY OF DATA AND MATERIALS – N/A**

### **COMPETING INTERESTS**

Authors declared that there are no competing interests in the publication of this manuscript.

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### **AUTHORS' INFORMATION**

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### ***Contributions***

All authors were involved in project conceptualization and design. P.J.L, DKC, DRM, and C.J.B conducted data collection and data analysis. J.S.L provided supervision and logistical support during the data collection phase. P.J.L, DKC, DRM, C.J.B, and CAL draft manuscript. J.S.L and W.A.P provided technical inputs for final manuscript.

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## Figures

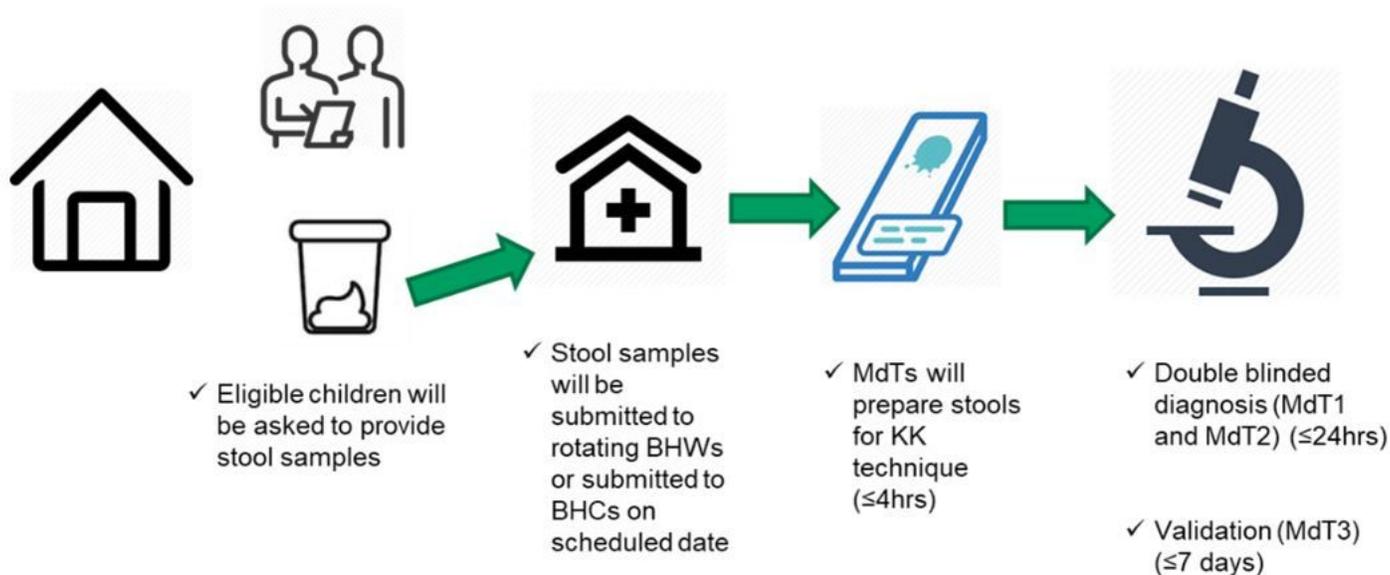


Figure 1

Data collection process flow

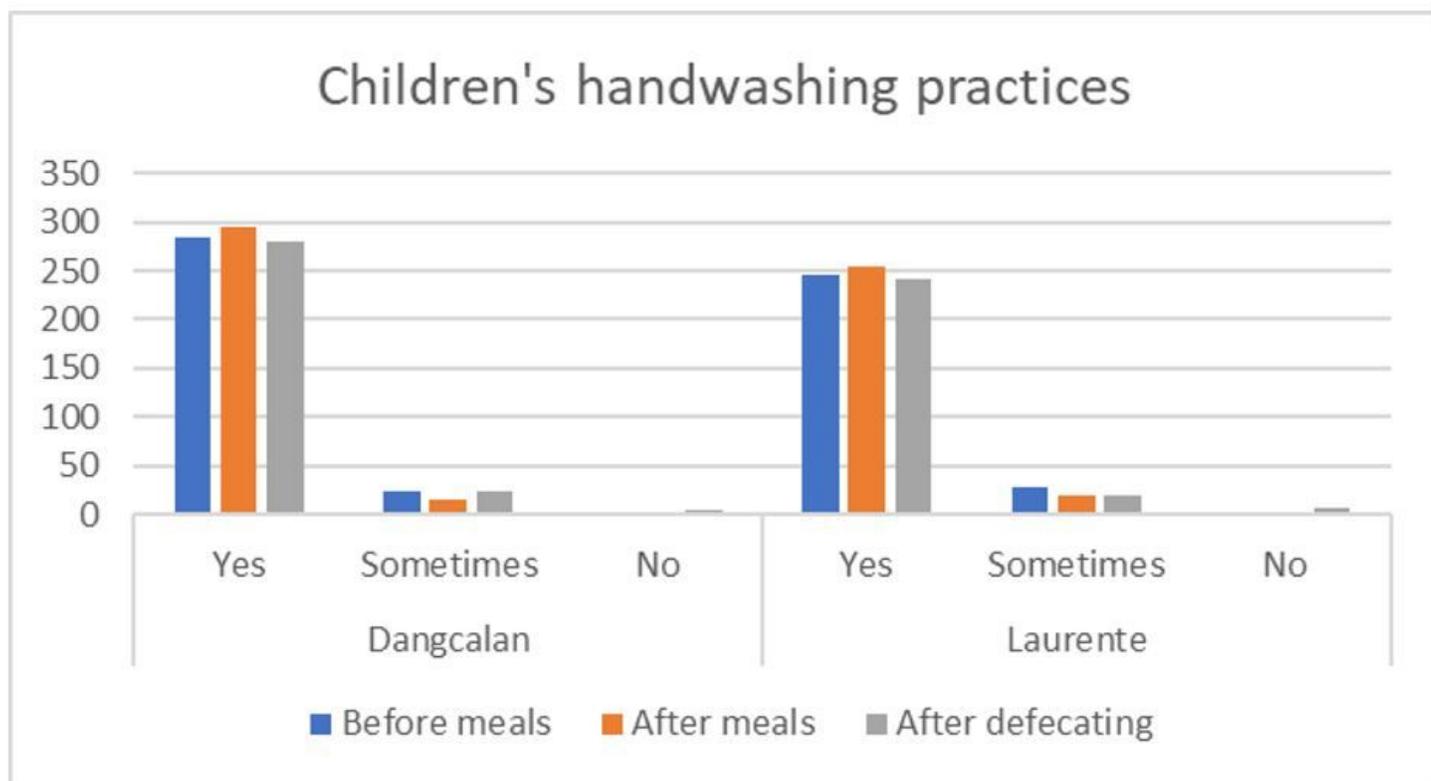
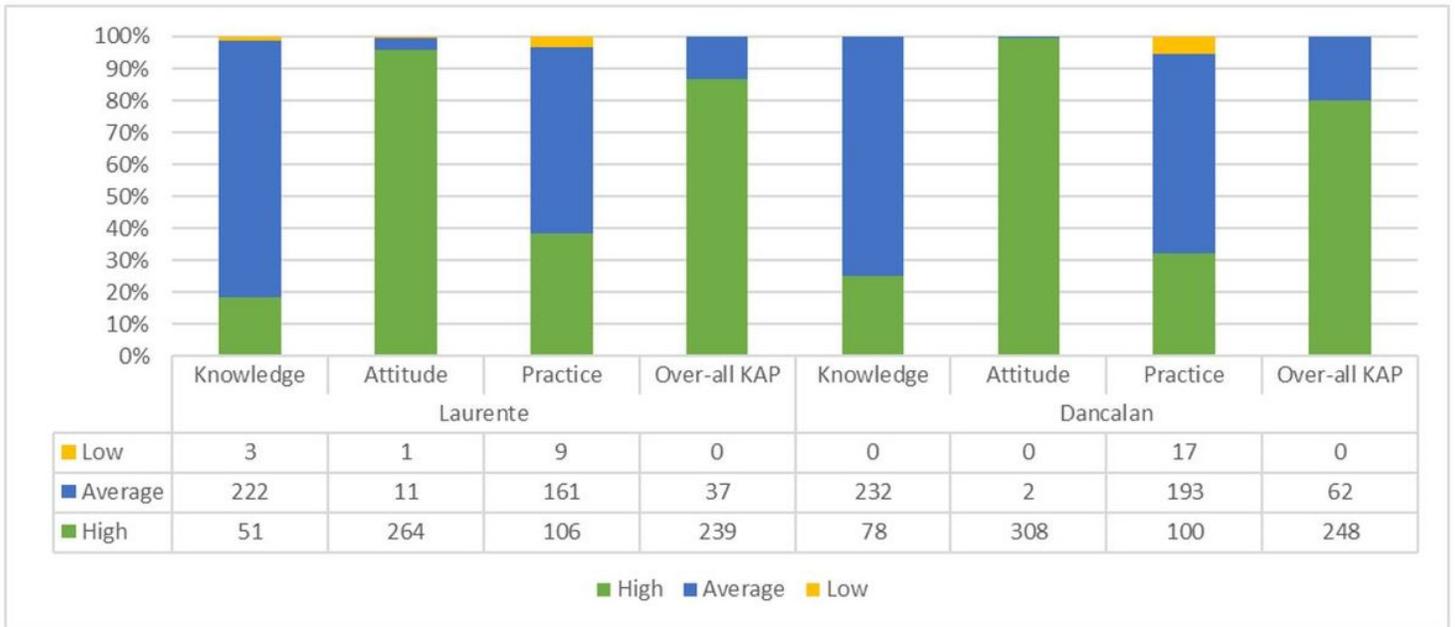


Figure 2

Reported handwashing practice among children



**Figure 3**

Household KAP score range