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Original research article

Prevalence of and Risk Factors Associated with Parasitic, Bacterial and Viral Infections among Children with Gastrointestinal Illness in Bamrasnaradura Infectious Diseases Institute

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ABSTRACT

Children living in developing countries are particularly susceptible to infectious gastrointestinal illnesses because of poor standards of hygiene and sanitation. Infectious gastrointestinal illnesses in Thailand remain the major health problems in children. This study aimed to determine the prevalence of intestinal infections and risk factors among the children with gastrointestinal illnesses at Bamrasnaradura Infectious Diseases Institute during June 2016 to September 2016. Stool samples were collected from eighty two children and examined for parasitic, bacterial, and viral infections. Demographic data and risk factors were collected using standardized questionnaire. Descriptive statistics were used to analyze the prevalence and demographic data. Risk factors were analyzed using binary logistic regression.

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The prevalence of parasitic infections was 26.8% (22/82) whereas the prevalences of bacterial infections and viral infections were 14.5% (10/69) and 9.8% (6/61), respectively. The most intestinal parasitic, bacterial and viral infections were *Blastocystis* sp. (15.9%), *Salmonella* spp. (8.7%) and Rotavirus (9.8%), respectively. Binary logistic regression showed a significant association of intestinal infections in children who lived with many young children in the same house (odds ratio: 2.6, 95% CI: 1.0–6.9, *p=0.045*). These findings indicate that living conditions and personal hygiene of children should be improved in order to prevent these infectious gastrointestinal illnesses.

Keywords: Prevalence; Infectious gastrointestinal illnesses; Children; *Blastocystis*; *Salmonella*; Rotavirus

1. Introduction

Intestinal infections remain a major public health problem in Thailand. A wide range of microorganisms including parasites, bacteria and viruses can cause intestinal disorders. Pathogenic organisms usually found in contaminated water and food. It is also commonly found in unimproved sanitation and lacking of hygiene [1-2]. Clinical symptoms of gastrointestinal disorders can be asymptomatic to severe gastrointestinal disorders in humans such as abdominal pain, nausea, vomiting, fatigue and diarrhea [1]. Diarrhea in children is still an important problem in public health. According to the WHO, diarrhea is the second leading cause of the death in children under five years old. Each year around 525,000 children were killed [1]. It is very important to diagnose the causes of diarrhea as earliest as possible. Therefore, this study aimed to determine the prevalence and risk associations of intestinal infections (parasites, bacteria and viruses) in children with gastrointestinal disorders at the Pediatric Inpatient Department, Bamrasnaradura Infectious Diseases Institute.

2. Materials and Methods

2.1 Study population and study design

A cross-sectional survey was carried out from June 2016 to September 2016, included gastrointestinal symptomatic children at Pediatric Inpatient Department, Bamrasnaradura Infectious Diseases Institute. A total of 82 children admitted to and diagnosed with gastrointestinal disorders were recruited. All children's stool samples were tested for parasite examination. However, other tests were depended on doctor's requirements. Their parents were asked to sign an assent form. This study was reviewed and approved by the Ethical Committees of Thammasat University and Bamrasnaradura Infectious Diseases Institute.

2.2 Stool collection and examination

Sterile plastic containers and Carry-Blair transport medium tubes were distributed to the nurses at Pediatric Inpatient Department. Standard procedures for stool specimen collection were informed to the nurses. All stool samples were carried in ice boxes and transported immediately to the Microbiology and Virology laboratories at Bamrasnaradura Infectious Diseases Institute for bacterial and viral identification.

For bacterial identification, fecal specimens were cultured directly on Blood agar base no 2, MacConkey agar, *Salmonella-Shigella* agar (Oxoid, Thermo Fisher Scientific, UK) and TCBS agar (Eiken Chemical, Japan) at 37^{o}C for 24

hours. To identify *Campylobacter*, fecal samples were also cultured on *Campylobacter* blood-free agar with CCDA selective supplement, Sheep blood agar base no.2 with Skirrow selective supplement (Oxoid, Thermo Fisher Scientific, UK) and incubated at 37ºC for 48 hours under microaerophilic conditions (10%CO_2, 5%O_2, 85%N_2). All suspected pathogenic bacteria colonies on agar plates were identified using microbiology laboratory process.

For viral identification, fecal specimens were investigated Rotavirus and Adenovirus using Rida Quick rotavirus/adenovirus Combi test (R-Biopharm AG, Darmstadt, Germany).

For parasite investigation, stool samples were examined by wet smear preparation in normal saline solution. Each stool sample was cultured in Jones' medium supplemented with 10% horse serum and incubated at 37°C for 48–72 hours to identify *Blastocystis* sp.. All specimens were then processed using the phosphate-buffered saline (PBS)-ethyl acetate sediment concentration technique and microscopically examined. Each stool specimen was also examined for *Cryptosporidium* spp., *Cystoisospora belli*, *Cyclospora cayetanensis* using modified acid-fast staining and microsporidia using Gram-chromotrope staining.

2.3 Questionnaire

To determine the risk factors, a standardized questionnaire was prepared to elicited information on the demographic data (age and gender) medical backgrounds (diarrhea and dysentery, abdominal pain, stomach pain, bloating, vomiting & nausea), environmental sanitation and living condition characteristics (contact with domestic animals and area around the house). For infants, signs and symptoms were asked from their parents and observed from medical records.

2.4 Statistical analysis

Prevalence and risk factors for intestinal infections were evaluated. Prevalences and demographic data were analyzed and presented as frequencies and percentages. Independent risk associations were analyzed using binary logistic regression. The level of significance was set at *5%.*

3. Results and Discussion.

Of eighty two individual children, who had gastrointestinal disorder and admitted at Pediatric Inpatient Department**,** Bamrasnaradura Infectious Diseases Institute, there were 49 (59.8%) male and 33 (40.2%) female. The pediatric patients aged 2 months–17 years (Mean ± SD: 2.4 ± 2.9 years). For data analysis, children were divided into 2 groups (age < 7 yr, ≥ 7 yr). Children were less than 7 years of age, their behaviors such as crawling, walking and playing had higher chance for intestinal infection.

3.1 The prevalences of intestinal infections.

The prevalence of intestinal parasitic infections was 26.8% (22/82), while 14.5% (10/69) and 9.8% (6/61) were positive for bacterial and viral infections, respectively. The most common parasite found in these children was *Blastocystis* sp. (15.9%). *Salmonella* spp. was the most common bacterial infection (8.7%). Rotavirus was positive in 6 cases (9.8%). One patient had co-infection with *Blastocystis* sp. and *Salmonella* spp. The prevalences of intestinal infections are shown in Table 1.

Table 1. The prevalences of intestinal infections.

Microorganisms	N	(%)
Parasite infection (N=82)		
Blastocystis sp.*	13	(15.9%)
Ascaris lumbricoides	4	(4.9%)
Hookworms	4	(4.9%)
Trichuris trichiura	1	(1.2%)
Total	**22**	**(26.8%)**
Bacterial infection (N=69)		
Salmonella spp.*	6	(8.7%)
Aeromonas hydrophila	1	(1.4%)
Campylobacter jejuni	1	(1.4%)
Plesiomonas shigelloides	1	(1.4%)
Vibrio cholerae NAG group 2	1	(1.4%)
Total	**10**	**(14.5%)**
Viral Infection (N=61)		
Rotavirus	6	(9.8%)
Total	**6**	**(9.8%)**

*1 case was co-infection (*Blastocystis* sp. & *Salmonella* spp.)

3.2 Risk factors of intestinal infections.

Binary logistic regression was used to analyze independent risk factors of intestinal infections. The variables of infections influenced by demographic characteristics and environmental sanitations are shown in Table 2. Univariate analysis showed that children who lived with many young children in the same house had a significantly high risk of acquiring the intestinal infections with crude odds ratio of 2.6 and 95% CI of 1.0–6.9 (*p=0.045*). There have no significant associations between intestinal infections and other factors such as gender, age groups, underlying disease (HIV, tumor, thalassemia, G6PD, nephrotic epilepsy and asthmas), putting hand in the mouth, contact domestic pet and area around the house ($p > 0.05$).

Table 2. Univariate analysis of risk factors for intestinal infections.

Characteristics	No. of enroll subject	Prevalence of infection N	(%)	Crude OR (95% CI)	*P*
Sex					
Male	49	24	(48.9)	1	
Female	33	13	(39.4)	0.7 (0.3-1.7)	0.393
Age groups					
Age < 7 years	74	34	(45.9)	1	
Age ≥ 7 years	8	3	(37.5)	0.7 (0.2-3.2)	0.650
Diarrhea symptom					
No	31	12	(38.7)	1	
Yes	51	25	(49.0)	1.5 (0.6-3.8)	0.364
Abdominal pain					
No	63	29	(46.0)	1	
Yes	19	8	(42.1)	0.9 (0.3-2.4)	0.763
Fever					
No	27	8	(29.6)	1	
Yes	55	29	(52.7)	2.6 (0.9-7.0)	0.052

Underlying disease					
No	72	30	(41.7)	1	
Yes	10	7	(70.0)	3.3 (0.8-13.7)	0.105
Living with many young children in the same house					
No	56	21	(37.5)	1	
Yes	26	16	(61.5)	2.6 (1.0-6.9)	*0.045**
Putting hand in the mouth					
No	33	14	(42.4)	1	
Yes	49	23	(46.9)	1.2 (0.5-2.9)	0.687
Contact domestic pet					
No	52	20	(38.4)	1	
Yes	30	17	(56.6)	2.0 (0.8-5.2)	0.113
Area around the house					
Concrete	71	31	(43.6)	1	
Wetlands	11	6	(54.5)	1.5 (0.4-5.5)	0.502

Note: * Significant at *p*-value < 0.05, OR = odds ratio; CI = confidence interval.

3.3 Discussion

In the present study, the predominant intestinal pathogenic protozoan and bacteria species were *Blastocystis* sp. (15.9 %) and *Salmonella* spp. (8.7%), respectively. One patient was co-infected with *Blastocystis* sp. and *Salmonella* spp. The prevalence of intestinal parasitic infections among children was 26.8% which was higher than the prevalence of bacterial and viral infections. These results were similar to those reported by Pipatsatitpong D. *et.al* study [3]. A cross-sectional survey showed predominant *Blastocystis* and *Salmonella* infections among children in a child care center, Bangkok, Thailand. *Blastocystis* sp. is one of the most common intestinal microorganisms found in Thai children. The prevalence studies of *Blastocystis* infection in Thai children were usually conducted in the communities or child care institutes. A few studies in child care institutes in Thailand showed the prevalence of *Blastocystis* infection ranged between 13.6% to 45.2% [3-7]. The same range of prevalence was also found in those studies of *Blastocystis* infection in school children [8-13]. The present study found the prevalence of *Blastocystis* infection in the hospitalized children who presented with gastrointestinal symptoms including diarrhea and abdominal pain. Although *Blastocystis* sp. has been considered as a pathogen [14-15], most of *Blastocystis* infection in humans are asymptomatic. In those who presented with clinical manifestations, the most common symptoms associated with *Blastocystis* infection are diarrhea, abdominal pain and vomiting. In this study, 84.6% (11/13) and 61.5% (8/13) of the children were positive for *Blastocystis* sp. had abdominal pain and diarrhea, respectively. However, no statistical association between *Blastocystis* infection and these symptoms was identified (data not shown).

The present study showed that *Salmonella* spp. was the most common bacterial causative agent in the children who

presented with gastrointestinal illnesses. A few studies in different period of time in Thailand indicated that *Salmonella* spp. remains one of the common causes of diarrhea in Thai children [16-18]. A study of at Bamrasnaradura Infectious Disease Institute, Thailand, from 1994 to 1996 showed that Nontyphoidal *Salmonella* spp. commonly caused diarrhea in young children especially the first 2 years of life [19]. *Salmonella* group B was the most common serogroup. A study of children with diarrhea caused by Nontyphoidal *Salmonella* spp. at Queen Sirikit National Institute of Child Health (QSNICH), Thailand in 2009 also showed the similar results [20]. Gastrointestinal illnesses caused by viral infections are also prevalent in Thailand. One of the common causes remains Rotavirus [16-18, 21].

Shared or different route of transmission may occur for different causative agents of gastrointestinal illnesses. The present study found that the independent risk association of gastrointestinal infections was living with many young children in the same house. It might be an evidence of person-to-person transmission. According to the most common microorganisms in the present study, i.e., *Blastocystis* sp., *Salmonella* spp. and Rotavirus, person-to-person transmission could occur [3, 6, 22-23]. One study reported that infected children had a higher risk of acquiring blastocystosis than those who lived in the rooms without infected children/child care workers [3]. A few studies showed that *Blastocystis* infection could be transmitted via person-to-person, waterborne, and zoonotic [24]. *Blastocystis* sp. is a common intestinal microorganism that can infect humans and a wide range of animals worldwide. To date, at least 17 subtypes of *Blastocystis* sp. have been reported. Since several subtypes can be detected both in humans and animals, zoonotic transmission has been proposed [15, 25]. In addition, waterborne is one of the common routes of transmission of *Blastocystis* infection. A few studies showed the evidence of waterborne transmission of *Blastocystis* sp. in Thai communities [10, 26-27].

4. Conclusion

These findings indicate that living conditions and personal hygiene of children should be improved in order to prevent these infectious gastrointestinal illnesses.

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