

The accuracy of formol-ether concentration in diagnosing soil-transmitted helminths in elementary school 27 Peusangan in Bireuen

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Abstract. Soil-transmitted helminths (STH) or a group of parasitic nematode worms causing human infection through contact with moist soil may contribute to anemia, nutritional disorders, physical and intellectual growth retardation. School-age children are at high risk of STH infection due to frequent contact with soil. Reliable, sensitive, and practical diagnostic are the test series for detecting STH. This study aimed to assess the sensitivity and specificity of the formol-ether concentration (FEC) in the diagnosis of STH when compared to the Kato-Katz technique. The study was designed at state elementary school 27 Peusangan, Bireuen. The FEC study on a total of 80 (100%) elementary students showed that 12 (15%) sample had the STH infection, while Kato-Katz technique (Gold standard) showed that 31 (38.75%) sample had the STH infection. The FEC technique has the sensitivity of (38.71%), specificity of (100%) and accuracy of (76.25%). The Kato-Katz technique is better than the FEC technique for assessing STH in Bireuen due to mild infection.

1. Introduction

Soil-transmitted helminths (STH) also called geohelminth are the intestinal worms infecting humans that are transmitted through contaminated soil¹. According to the World Health Organization (WHO, 2006) in Renanti et al reported that STH infections (*Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm) reached 500 million people in Southeast Asia and 11 countries including endemic areas, one of which is Indonesia. The World Health Organization (WHO) currently recommends the use of the Kato-Katz method for diagnosing STH³ because it is easy to use and low cost⁴, but a study done by Taye (2014)⁵ in Ethiopia showed that Kato-Katz sensitivity was lower than FEC technique, among 669 primary school children, the sensitivities were *A. lumbricoides* 8.1%, *T. trichiura* 5.1%, and hookworm 5.8%, while by using the FEC techniques were *A. lumbricoides* (15.2%), *T. trichiura* (12.1%) and hookworm (12.1%).

There were needed diagnostic test in diagnosing STH infection which is sensitive, easy to use, accurate, low cost and concurrently detecting different STH in the same stool sample. The study to compare the accuracy of Kato-Katz technique with FEC technique has not been known in Indonesia,



especially in Bireuen, Aceh. Intestinal parasitic infections are common and mostly occurred on children. Therefore, this study is aimed to compare the sensitivity and specificity of FEC technique and Kato-Katz technique.

2. Materials and Methods

A diagnostic test study was to compare the sensitivity and specificity of FEC technique and the Kato-Katz technique for diagnosing STH infection. This study was conducted on the elementary school students of grade I-VI, in Peusangan Bireuen, from May-December 2016. There were 80 samples selected using simple random sampling. Students who were willing to be participants on the study signed the consent letter of a parent or guardian. The study chose students who had the ability to give stool samples.

Students were provided with plastic stool cups and asked to bring the fresh stool of their own. The 10% formalin solution was mixed into the stool cups. Approximately 3gr of the stool specimen was used to prepare by FEC technique and 41.7mg of the stool specimen for Kato-Katz technique. All the samples were processed at the laboratory of Parasitology Department of Faculty Medicine, University of North Sumatera. Ethical clearance was approved by Faculty of Medicine, University of North Sumatera. All subjects gave the informed consent letters.

3. Results

There were 80 participants in the study. The majority of the participants were female (55%), 25% of them were in grade V, the parents' occupation were farmers (father 62%); mother (58%), the parents' education were senior high school (father 36.3%), and junior high school (mother 38.8%).

Table 1. Frequency distribution based on characteristic.

Characteristic	Category	n	%
Gender	Male	36	45.0
	Female	44	55.0
Grade	I	18	22.5
	II	16	20.0
	III	9	11.3
	IV	8	10.0
	V	20	25.0
	VI	9	11.3
Father occupation	Farmer	50	62.5
	Entrepreneur	24	30.0
	Government employees	6	7.5
Mother occupation	Farmer	47	58.8
	Entrepreneur	9	11.3
	Government employees	5	6.3
	Housewife	19	23.8
Father education	Elementary School	23	28.8
	Junior High School	21	26.3
	Senior High School	29	36.3
	Graduate Degree	7	8.8
	Elementary School	17	21.3
Mother education	Junior High School	31	38.8
	Senior High School	29	36.3
	Graduate Degree	3	3.8

Table 2 shows the highest frequency STH infection by Kato-Katz technique were *T. trichiura* (27.5%) compared with *A. lumbricoides* (6.25%) and hookworm (13.75%).

Table 2. The frequency distribution of test results with Kato-Katz technique.

Type STH	Result	Kato-Katz Technique	
		n	%
<i>A. lumbricoides</i>	Positive	5	6.25
	Negative	75	93.75
<i>T. trichiura</i>	Positive	22	27.5
	Negative	58	72.5
Hookworm	Positive	11	13.75
	Negative	69	86.25

Table 3 shows the highest frequency STH infection by FEC technique were *T. trichiura* (10%), compared with *A. lumbricoides* (5%), and hookworm (5%).

Table 3. The frequency distribution of test results with FEC technique.

Type STH	Result	FEC Technique	
		n	%
<i>A. lumbricoides</i>	Positive	4	5.0
	Negative	76	95.0
<i>T. trichiura</i>	Positive	8	10.0
	Negative	72	90.0
Hookworm	Positive	4	5.0
	Negative	76	95.0

The diagnostic value of examination by FEC method in detecting STH infection was obtained by tabulating the data and inserting them into 2x2 table, then calculate the sensitivity, specificity, NPV, PPV and accuracy values using then related formulas. Based on table 4 obtained sensitivity value 38.71%, specificity 100%, positive predictive value (PPV) 100%, negative predictive value (NPV) 72.1%, and accuracy 76.25%.

Table 4. Comparison the FEC technique comparison with Kato-Katz as gold standard in diagnosing STH infection.

FEC Technique		Kato-Katz Technique		
		Positive	Negative	Total
Measurement	Positive	12	0	12
	Negative	19	49	68
Total		31	49	80

4. Discussion

This study reported the characteristics of participants' distribution. Soil-transmitted helminths infection common in school children. Male and female have a similar frequency in STH infection because the children have poor behavior, poor hygiene practice and school environment have poor hygiene sanitary. Peusangan is agriculture area; more people work as farmers. Parents who had high education had more knowledgeable in good personal hygiene practice to prevent disease. This study was similar to study which was done by Handayani et al showed the majority distribution of participants were male (52.1%), parents occupation were a farmer (father 38.4%) and housewife (mother 76.7%), education level of parents were high school (father 38.4%) and junior high school (38.8%) among 73 students of state elementary school 169 Gandus district in Palembang⁶. Soil-transmitted helminths infection is common in school-age children because of their habits of playing with soil⁷. The soil is media for the growth and development of helminthes egg⁶. The other factors can cause STH infections

are people without foot wear, not washing hands before eating by soap and biting the nail⁹. Mothers with higher education have better knowledge of nutrition and personal hygiene⁷.

This study shows that the highest prevalence of STH infection by the FEC and Kato-Katz technique were *T. trichiura* with 10% and 27.5%. Since the light STH infection is often asymptomatic, children are not treated or inadequately administered treatment. For instance, *T. trichiura* infection treatment is not given with 3 doses. The average temperature at study field is 30° C and the soil type is alluvial, which is suitable medium as it contains lots of sand and clay. This study was similar to the study done by Torres et al showing that *T. trichiura* infection had the highest prevalence (34%) compared to *A. lumbricoides* (22.3%) and hookworm infection (22%) by the Kato-Katz technique¹⁰. This study is different from the study done by Taye in Ethiopia (2014) showing that the prevalence *A. lumbricoides* infections were higher (15.2% and 8.1%) compared to *T. trichiura* (12.1% and 5.1%) and hookworm (12.1% and 5.8%) infection due to poor hygiene, unboiled water, and dirty food. Risk factors for STH infection and high prevalence are not caused by a single factor, but influenced by various factors: biological, social, behavioral and environmental factors such as poverty. Previous studies in tropical countries show that environment and behavioral factors affect the degree of STH infection¹¹.

This study reported the diagnostic test FEC compared with Kato-Katz technique gave a sensitivity of (38.71%), a specificity of (100%), a PPV of (100%), a NPV of (72.1%), and an accuracy of (76.25%). The low sensitivity of the FEC technique because the disadvantages of it was the procedure can make it damage the eggs. Other reasons may be the timing mismatch so not all parasites were settled in the specimen. On the other hand, Kato-Katz technique found more positive worm eggs. This study was similar to the study performed by Endris et al in Ethiopia (2013) showing that the sensitivity of FEC (78.3%) was lower than the sensitivity of the Kato-Katz technique (81%)⁸. The Kato-Katz technique had lower detection than the FEC technique for detecting hookworm is explained by the following fact that hookworm has lower egg laying capacity, more likely to be missed by Kato-Katz and hookworm eggs were disappeared due to glycerin as long time delays occurred between Kato-Katz smear preparation and microscopic examination⁸. Commonly it needed 3 minutes¹². Several studies have shown that good sensitivity in Kato-Katz has a value that varies between 74% and 95%³. The low FEC sensitivity is due to the possibility of eggs not being in slide¹². This study was not similar to the study performed by Taye in Ethiopia showing that the diagnosis of helminths infection by the FEC technique gave a higher positive result (73.5%) than using the Kato-Katz technique (40.7%)⁵. The low sensitivity of the Kato-Katz technique is probably due to the thick fecal preparations, and the slide examination time is less than 15 minutes after the slide preparation is made¹³. The use of stool samples examined slightly or less 41.7mg may cause a decrease in sensitivity of the Kato-Katz technique in detecting worm eggs STH⁹.

World Health Organization¹⁴ has recommended the use of the Kato-Katz technique as a gold standard in the STH infection examination, as the method is easy to use, low cost, and able to classify the intensity of infection based on the worm egg calculation. The weakness of the Kato-Katz is not able to detect protozoa cysts¹⁵.

The FEC technique has deficiencies due to the use of ether which may be harmful to laboratory personnel. Ether explosive, containing anesthesia, irritating the respiratory tract and may cause cardiovascular disorders¹⁶, whereas the advantages of FEC technique are stool samples can be examined in several hours or days after the stool preserved in formalin¹⁷. The method is also able to detect *trematode* eggs and protozoan cysts in feces samples¹⁸.

The FEC technique in this study has a deficiency in diagnosing STH infection. Low positive STH eggs detection requires longer processing time and more complicated techniques. The advantages of FEC technique in this study is that the feces can be examined several hours after preserved and then taken by researchers from Bireuen to the laboratory of the Department Parasitology Faculty of Medicine University of North Sumatera. Based on the diagnostic test in this study it can be suggested that the Kato-Katz technique has good accuracy in diagnosing STH infection, whereas the FEC technique is not a suitable diagnostic test for STH infection as it has a low sensitivity.

5. Conclusion

The Kato-Katz technique is better than the FEC technique for assessing STH infections in Bireuen due to mild infection. The prevalence of STH infection was highest in *T. trichiura*.

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