Comparison of Quantitative Fecal Examination Using the Stoll Method and the Kato-Katz Method in Detecting the Number of Soil-Transmitted Helminth Worm Eggs

Febrian Maulana[1], Iqrina Widya Zahara[2], Munauwarus Sarirah[3], Said Munazar Rahmat[4]

[1]Faculty of Medicine and Health Sciences, Muhammadiyah University of North Sumatra, [2,3,4]Department of Parasitology, Faculty of Medicine and Health Sciences, Muhammadiyah University of North Sumatra

Email: rian02maulana@gmail.com, iqrinawidyazahara@umsu.ac.id, munauwarussarirah@umsu.ac.id, saidmunazar@umsu.ac.id

Soil-Transmitted Helminths (STH) are a group of parasitic worms transmitted through contaminated soil, with prevalence remaining high, particularly among elementary school-aged children. Detection of STH eggs through microscopic stool examination can be performed using the Stoll and Kato-Katz methods. Although both are quantitative methods frequently used, a comparative analysis of their detection results requires further investigation. To compare the number of STH eggs detected using the Stoll method and the Kato-Katz method in stool samples from elementary school students. This research was an analytical study with a cross-sectional design. A total of 67 stool samples from students at SDN 101931 Perbaungan were examined using the Stoll and Kato-Katz methods. Data were analyzed using the Wilcoxon test. Most samples tested negative for STH infection. The Kato-Katz method detected four positive cases (6.0%), while the Stoll method detected one positive case (1.5%). The types of worms detected using the Kato-Katz method were Ascaris lumbricoides and Trichuris trichiura, with average egg counts of 750 and 37.5 eggs per gram of stool (EPG), respectively. The Stoll method detected only Ascaris lumbricoides, with an average egg count of 200 EPG. The Wilcoxon test showed no statistically significant difference in the number of Ascaris lumbricoides eggs detected by the Kato-Katz and Stoll methods ($p = 0.068$). No statistically significant difference was found in the number of Ascaris lumbricoides eggs detected by the Stoll and Kato-Katz methods. However, the Kato-Katz method detected more positive samples and both STH species identified in this study, whereas the Stoll method detected only Ascaris lumbricoides. These findings suggest that the Kato-Katz method may provide greater detection yield under the conditions of this study, while the Stoll method may serve as an alternative for quantitative stool examination.

Keywords: Soil-Transmitted Helminths, Stoll Method, Kato-Katz Method, Helminth Eggs, Stool Examination.

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Corresponding Author:
Febrian Maulana
Faculty of Medicine and Health Sciences, Muhammadiyah University of North Sumatra
rian02maulana@gmail.com

1. Introduction

Soil-Transmitted Helminths (STH) are a group of nematode worms that infect the human digestive tract. Transmission is closely linked to soil contaminated with infective eggs or larvae. Transmission can occur when a person ingests helminth eggs through soil-contaminated food, drink, or hands, while hookworm infection can occur through penetration of larvae into the skin. Humid environmental conditions, poor sanitation, and poor hygiene habits can support the worm's life cycle and increase the risk of transmission to humans. Therefore, STH infection remains a public health problem that requires attention, particularly in areas with inadequate access to sanitation and hygienic practices (1).

The types of worms included in the STH group and most frequently infecting humans are Ascaris lumbricoides, Trichuris trichiura, and hookworms, including Necator americanus and Ancylostoma

duodenale. Each type of worm has different morphological characteristics and life cycles, but all can cause health problems when infecting humans. Mild infections sometimes show no obvious symptoms, while moderate to severe infections can cause digestive disorders, blood loss, anemia, nutritional deficiencies, and stunted growth and development in children. The severity of the infection is related to the number of worms infecting the body, so tests that can identify the type and estimate the intensity of the infection are essential (2).

STH infections remain a global health problem because they can affect various age groups, especially children living in environments with inadequate sanitation. Environmental transmission makes these infections difficult to control without improved sanitation, health education, and appropriate treatment programs. In Indonesia, worm infestation is also a concern in efforts to improve public health. The Indonesian Ministry of Health has established a policy for worm infestation control through Regulation of the Minister of Health of the Republic of Indonesia Number 15 of 2017. This policy serves as a basis for implementing worm infestation prevention and control efforts, especially in groups at risk of infection (3).

The high risk of STH infection indicates that control efforts cannot be achieved solely through the administration of deworming medication. Diagnostic tests are also needed to identify infections and estimate their severity. Diagnostic tests play a role in supporting epidemiological surveillance, determining infection intensity, and evaluating the success of treatment and worm control programs. Accuracy of test results is crucial because differences in diagnostic method capabilities can affect the number of cases identified and the assessment of the success of health interventions. Therefore, selecting an appropriate test method is a crucial part of STH infection control, both in laboratory services and research activities (4).

One approach used to diagnose STH infections is microscopic stool examination. This examination is performed by observing stool samples to identify worm eggs based on their morphological characteristics. In general, examination can be performed qualitatively to determine the presence of worm eggs and quantitatively to estimate the number of worm eggs in a given stool sample. Quantitative examination has the further benefit of providing an indication of infection intensity based on the number of eggs found. These results can be used to support epidemiological assessments and monitoring of worm control programs. However, the accuracy of examination results is influenced by sample quality, stool homogenization, examination procedures, and the method's ability to detect worm eggs at different concentrations (5).

One quantitative stool examination method is the Stoll method, a technique used to estimate the number of worm eggs by diluting a stool sample and counting them under a microscope. This method allows the number of eggs found to be converted into an estimate of the number of eggs per gram of stool, depending on the procedure and dilution factor used. The advantage of the Stoll method lies in its relatively simple procedure and its ability to produce quantitative data on worm egg density. This method can be used in laboratory tests and research aimed at comparing the intensity of worm infections. However, test results still depend on the accuracy of the sample weighing and dilution, stool homogenization, and the examiner's accuracy when counting worm eggs under the microscope (6).

In addition to the Stoll method, the Kato-Katz method is a widely used stool examination technique for quantitatively detecting and counting STH worm eggs. This method uses a specific weight of stool prepared as a thick smear on a glass slide, which is then examined microscopically. The number of eggs found is counted and converted to the number of eggs per gram of stool based on the weight of the sample examined. The Kato-Katz method is widely used in epidemiological surveys because it can help determine infection intensity and support the evaluation of helminth control programs. However, the accuracy of the

results can be affected by the sampling process, mixing or homogenization of the stool, storage duration, storage temperature, and the time of reading the smear after preparation (7).

Although the Stoll and Kato-Katz methods are both used for quantitative examination of helminth eggs, they differ in sample preparation principles and counting procedures. These differences can potentially result in inconsistent egg counts, even when the stool samples come from the same individual. Furthermore, the distribution of helminth eggs in the stool is not always uniform, so taking a portion of the sample can affect the observed egg count. Research on the effect of stirring and storage conditions on egg counting using the Kato-Katz method indicates that technical factors in sample handling must be considered to obtain consistent results. Therefore, a comparison of the two methods needs to be conducted using standardized examination procedures to more objectively assess differences in results (7).

The selection of an examination method also requires consideration of each technique's ability to detect helminth eggs at different levels of infection. In infections with low egg counts, the likelihood of not finding eggs in a microscopic smear increases, so a negative examination result does not necessarily rule out infection. Studies comparing the Kato-Katz method with real-time polymerase chain reaction-based diagnostic techniques demonstrate the importance of considering method sensitivity when detecting STH infections and evaluating treatment efficacy. While molecular-based examinations have certain advantages, quantitative microscopic methods remain relevant because they can provide direct estimates of helminth egg counts. Therefore, evaluating the Stoll and Kato-Katz methods is crucial to determine the concordance of their results in quantitative examinations (8).

Comparative research on stool examination methods is important because differences in count results can affect the interpretation of infection intensity and the utilization of laboratory data. Consistent test results are needed to support the assessment of helminth infestation, monitor changes in egg counts after treatment, and evaluate STH control programs. Method comparisons must utilize appropriate samples, standardized procedures, and consistent counting techniques. Egg counts found by each method can then be compared to identify differences in measurement results and assess the relationship between the two test results. This approach aligns with the need to develop efficient diagnostic strategies, particularly in large-scale surveys that require quantitative and comparable test results (9).

Based on the description, quantitative stool examination is an important aspect in the diagnosis and control of Soil-Transmitted Helminth infections. The Stoll method and the Kato-Katz method have different examination principles, but both can be used to estimate the number of worm eggs in the stool. Differences in preparation procedures, the number of samples examined, and other technical factors allow for variations in the counting results, so research is needed to compare the results of the two methods directly. Therefore, this study was conducted with the title "Comparison of Stool Examination Using the Stoll Method and the Kato-Katz Method Quantitatively in Detecting the Number of Soil-Transmitted Helminth Eggs." This study is expected to provide information regarding the differences in the results of worm egg counting using the two methods and become a consideration in selecting quantitative examination techniques in the laboratory.

2. Literature Review and Problem Statement

Soil-Transmitted Helminths (STH)

Soil-Transmitted Helminths (STH) are a group of intestinal nematodes transmitted through soil contaminated with infective eggs or larvae. The main species responsible for human infections include Ascaris lumbricoides, Trichuris trichiura, Necator americanus, and Ancylostoma duodenale. Infection commonly occurs in environments with poor sanitation, inadequate personal hygiene, and limited access to

clean water. The severity of infection is associated with the number of parasites present in the host and can range from asymptomatic infection to nutritional deficiencies, anemia, gastrointestinal disturbances, and impaired growth in children. Therefore, accurate laboratory diagnosis is important for identifying infections, estimating infection intensity, and supporting the evaluation of STH prevention and control programs (1).

Quantitative Stool Examination

Quantitative stool examination is a laboratory procedure used to determine the number of helminth eggs in a fecal sample, generally expressed as eggs per gram of stool (EPG). This examination provides information not only about the presence of infection but also about its intensity, which is important for epidemiological investigations and monitoring treatment outcomes. The reliability of quantitative examination depends on several factors, including the representativeness of the stool sample, sample homogenization, preparation techniques, microscopic observation, and the accuracy of egg counting. Differences in laboratory procedures may produce variations in egg counts, potentially influencing the interpretation of infection intensity. Consequently, selecting a suitable quantitative examination method is essential to obtain consistent and reliable diagnostic results (2).

Stoll Method And Kato-Katz Method

The Stoll method and the Kato-Katz method are quantitative techniques used to estimate the number of helminth eggs in stool samples. The Stoll method involves diluting a measured quantity of feces in a specified solution, followed by microscopic examination and calculation of the estimated egg count according to the dilution procedure. In contrast, the Kato-Katz method uses a measured amount of feces to prepare a thick smear that is examined microscopically, with the observed egg count converted into EPG using a specified multiplication factor. Both methods can provide quantitative information about STH infection, but their differences in sample preparation, the amount of feces examined, and counting procedures may influence the resulting egg counts. These differences make a direct comparison necessary to understand the agreement and potential variation between the two methods (3).

Problem Statement

Although the Stoll and Kato-Katz methods are both used for quantitative helminth egg examination, differences in their preparation and counting procedures may produce different estimates of the number of STH eggs in the same fecal sample. Such discrepancies may affect the classification of infection intensity and the interpretation of laboratory findings. Furthermore, variations in egg distribution within feces and the possibility of low egg counts may influence the consistency of microscopic examination results. Therefore, a comparative investigation is needed to determine whether there is a difference in the number of STH eggs detected using the Stoll and Kato-Katz methods. This study focuses on comparing the quantitative results obtained from both techniques to provide information that may support the selection of an appropriate method for laboratory examination and research.

3. Method

This research is an analytical study with a comparative test design using a cross-sectional design. This design was chosen because stool sampling was conducted at a single point in time to determine and compare the number of Soil-Transmitted Helminths (STH) eggs using two examination methods: the Stoll method and the Kato-Katz method. This study aims to obtain a quantitative picture of the number of STH worm eggs based on the results of examinations using both methods (10).

Stool samples obtained from research subjects were examined according to established criteria. Each sample was examined using the Stoll and Kato-Katz methods to determine the number of worm eggs found

in each method. The results were then expressed as eggs per gram (EPG), according to the counting procedure used. Using both methods on the same sample allowed for direct comparison of results, allowing for differences in the number of worm eggs detected (11).

The data obtained from both tests were then recorded, processed, and analyzed to determine the difference in STH egg counts between the Stoll and Kato-Katz methods. The analysis was conducted by considering the data characteristics and distribution of test results to ensure the statistical method used was appropriate for the research objectives. This comparison is expected to provide information on the suitability of the worm egg count results from the two methods and to inform the selection of quantitative stool examination methods in the laboratory (12).

4. Results and Discussion

Research result

The study was conducted in May 2025 at the Parasite Laboratory of the Faculty of Medicine, Muhammadiyah University of North Sumatra. Based on the approval of the Health Research Ethics Commission of the Faculty of Medicine, Muhammadiyah University of North Sumatra with number: 1507 / KEPK / FKUMSU / 2025. In this study there were 67 samples, namely feces that had been taken from students of SDN 101931 Perbaungan who had met the inclusion and exclusion criteria, and were willing to be research subjects through feces that had been taken by the researcher previously and the informed consent form that had been provided.

Based on the Kato-Katz method, four samples tested positive for STH infection (6%). The infection type was Ascaris lumbricoides in one sample (1.5%) and Trichuris trichiura in three samples (4.5%). Based on the Stoll method, only one sample tested positive for STH infection (1.5%), with the infection type being Ascaris lumbricoides (Table 1).

Table 1. Results of STH infection examination based on Kato-Katz Method and Stoll Method

Infection Status	Kato-Katz Method	Stoll Method
Positive STH	4 (6%)	1 (1.5%)
Ascaris lumbricoides	1 (1.5%)	1 (1.5%)
Trichuris trichiura	3 (4.5%)	0 (0%)
STH Negative	63 (94%)	66 (98.5%)
Total Sample	67 (100%)	67 (100%)

The average number of Ascaris lumbricoides eggs found using the Kato-Katz method was 750 eggs per gram of stool, while using the Stoll method it was 200 eggs per gram of stool. The average number of Trichuris trichiura eggs found using the Kato-Katz method was 37.5 eggs per gram of stool, while using the Stoll method no Trichuris trichiura eggs were found (Table 2).

Table 2. Average number of eggs using the Kato-Katz method and the Stoll method

Number of eggs	*Kato-Katz*	*Stoll*
Ascaris lumbricoides	750	200
Trichuris trichiura	37.5	-

Prior to bivariate analysis, the STH egg count data were tested for normality to determine the distribution. The Kolmogorov-Smirnov test was used because the sample size was >50.

Table 3. Normality Test

Variables	Distribution	p-value
Kato-Katz	Abnormal	<0.001
Stoll	Abnormal	<0.001

It is known that the valuep in table 3. above is <0.001. This indicates that the data is not normally distributed, so for bivariate analysis using an alternative test from the paired t-test, namely the Wilcoxon test. Bivariate analysis with the Wilcoxon test aims to determine the difference in the number of Ascaris lumbricoides eggs based on the Kato-Katz method and the Stoll method.

Table 4. Test for differences in the average number of STH eggs based on *Kato-Katz Method and Stoll Method*

Method	Number of STH eggs		p-value
	Ascaris Lumbricoides	Trichuris Trichiura	
Kato-Katz	750	200	0.068
Stoll	37.5	0	

Based on Table 4, the Wilcoxon test results show a p-value >0.05. This means there is no significant difference between the number of Ascaris lumbricoides eggs examined using the Kato-Katz method and the Stoll method. Based on the results of a study of 67 stool samples from students at SDN 101931 Perbaungan, examination using the Kato-Katz method showed positive results for Soil Transmitted Helminths (STH) infection in four samples (6.0%), while the Stoll method showed positive results in one sample (1.5%). The types of worms found using the Kato-Katz method were Ascaris lumbricoides in one sample and Trichuris trichiura in three samples, while the Stoll method only found Ascaris lumbricoides. These results indicate that the Kato-Katz method detected more positive STH samples than the Stoll method in this study.

Based on the number of worm eggs found, the average number of Ascaris lumbricoides eggs using the Kato-Katz method was 750 EPG, while the Stoll method was 200 EPG. In the Trichuris trichiura examination, the Kato-Katz method produced an average of 37.5 EPG, while the Stoll method did not find any worm eggs. The results of the normality test showed that the data were not normally distributed, so a comparative analysis was carried out using the Wilcoxon test. The analysis results showed a p-value of 0.068, which means there was no statistically significant difference between the results of the two methods based on the test because the p-value was greater than 0.05.

Overall, the Kato-Katz method detected a higher number of helminth eggs and identified more positive samples than the Stoll method. However, statistical test results did not show any significant differences in the reported analyses. These findings highlight the importance of considering detection capacity and examination procedures when selecting a quantitative method for STH helminth egg identification. Future research is recommended to involve a larger sample size and conduct standardized examinations to more accurately compare the results of the two methods.

Discussion

This study was conducted to compare the number of Soil-Transmitted Helminths (STH) eggs detected using the Stoll and Kato-Katz methods in 67 stool samples from students at SDN 101931 Perbaungan. The number of samples collected did not reach the initial target of 90 due to challenges during the collection process. Nevertheless, all samples that met the research criteria were still examined using both methods. This comparison aims to determine the differences in the results of quantitative worm egg counts and assess the ability of the two methods to detect STH infections. Quantitative examination is important because the number of worm eggs in stool can provide an overview of the intensity of infection and support the evaluation of helminthiasis in at-risk populations (Devi, 2020).

The results showed that the Kato-Katz method detected four positive STH samples, representing 6.0% of the total sample, while the Stoll method detected one positive sample, representing 1.5%. The Kato-Katz method detected one positive sample for Ascaris lumbricoides and three positive samples for Trichuris

trichiura. Meanwhile, the Stoll method detected only one positive sample for Ascaris lumbricoides. This difference indicates that the Kato-Katz method detected more positive samples in this study. The ability to detect a wider range of helminth egg types can be an important consideration in laboratory testing, especially when testing is conducted in populations with a low likelihood of infection (Khurana et al., 2021).

Based on the number of worm eggs found, the average number of Ascaris lumbricoides eggs in the Kato-Katz method was reported to be 750 eggs per gram of stool (EPG), while the Stoll method reported 200 EPG. In the Trichuris trichiura examination, the Kato-Katz method yielded an average of 37.5 EPG, while the Stoll method did not detect any worm eggs. These results demonstrate a descriptive difference in the number of eggs detected by the two methods. These differences may be related to sample preparation characteristics, the amount of stool examined, the homogenization process, and the uneven distribution of worm eggs in the stool. Therefore, standardization of examination procedures is important to maintain consistency in worm egg count results (Bosch et al., 2021).

Statistical analysis using the Wilcoxon test showed a p-value of 0.068, indicating no statistically significant difference between the results of the two methods at the 0.05 level of significance. Although the Kato-Katz method detected more positive samples and reported a higher number of eggs, these findings are not sufficient to conclude that the Kato-Katz method is statistically superior to the Stoll method. The relatively small number of positive samples may also limit the study's ability to detect significant differences. Therefore, interpretation of the results requires considering the statistical value, the number of samples analyzed, and the distribution of egg numbers in each sample, rather than simply comparing the average numbers of the two methods (Coffeng et al., 2023).

The results of this study can be compared with previous studies that discussed the quantitative examination of STH worm eggs using various diagnostic methods. Devi's (2020) study specifically discussed the comparison of STH worm egg counts using the Stoll and Kato-Katz methods, making it relevant as a comparison in assessing the results of the two methods. Meanwhile, Setiawan et al.'s (2022) study discussed STH worm egg counts using sedimentation and flotation methods, demonstrating the importance of considering examination principles in interpreting worm egg detection results. Abelira and Mutiara's (2023) study also compared stool examinations using the formol-ether sedimentation and Kato-Katz methods. However, because the methods and parameters used were different, the results of these studies need to be compared carefully and cannot be directly assumed to show the same pattern of differences as this study.

Overall, this study shows that the Kato-Katz method detected more STH-positive samples than the Stoll method, but the Wilcoxon test results did not show a statistically significant difference. These findings suggest that the selection of an examination method needs to be adjusted to the examination objectives, sample characteristics, quantitative calculation needs, and the availability of laboratory facilities and resources. Future research is recommended to involve a larger sample size and ensure that both methods are performed on the same sample using standardized procedures. Furthermore, the number of eggs per sample needs to be analyzed in pairs to more accurately evaluate differences in the results of the two methods. Therefore, the results of this follow-up study are expected to provide stronger evidence regarding the comparison of the Stoll and Kato-Katz methods in detecting STH worm eggs.

5. Conclusion

Based on the results of research conducted on 67 fecal samples of students of SDN 101931 Perbaungan, the number of Ascaris lumbricoides and Trichuris trichiura eggs obtained using the Kato-Katz method was 750 and 37.5 eggs per gram of feces (EPG), respectively. Meanwhile, examination using the Stoll method

showed the number of Ascaris lumbricoides eggs was 200 EPG, while Trichuris trichiura eggs were not found. The types of STH worms identified by the Kato-Katz method were Ascaris lumbricoides and Trichuris trichiura, while the Stoll method only identified Ascaris lumbricoides.

Based on the results of statistical analysis using the Wilcoxon test, a p-value of 0.068 ($p > 0.05$) was obtained, so there was no statistically significant difference between the number of Ascaris lumbricoides eggs examined using the Stoll method and the Kato-Katz method. However, descriptively there was a difference in the number of eggs detected by the two methods. Thus, the results of this study indicate that the Kato-Katz method detected more types and positive samples of STH than the Stoll method, but the difference in the number of Ascaris lumbricoides eggs between the two methods was not statistically significant based on the test results obtained.

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