Accurate Diagnosis of *Schistosoma mansoni* and *S. haematobium* from Filtered Urine Samples Collected in Tanzania, Africa

Koreena Miller and **Nilanjan Lodh**

Department of Medical Laboratory Science, College of Health Sciences, Marquette University, Milwaukee, WI, USA

MARQUETTE UNIVERSITY
College of Health Sciences
Medical Laboratory Science

Marquette University
(414) 288-3404
nilanjan.lodh@marquette.edu

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ABSTRACT

Introduction: Schistosomiasis is a bloodborne, and waterborne parasitic disease caused by human *Schistosoma* species, namely *Schistosoma mansoni* and *S. haematobium*. The parasite requires an intermediate snail host, where they grow and develop, along with a human host (definitive). *Schistosoma* egg detection in feces and urine are the confirmatory diagnostic tests.

Methods: The goal of our research was to determine the efficacy of detecting single or dual Schistosome parasites from filtered human urine samples collected in Tanzania by amplifying species-specific cell-free repeat DNA fragments via polymerase chain reaction (PCR) and gel electrophoresis. 104 filtered human urine samples were evaluated and collected from citizens residing in the village of Kayenze, Tanzania. All samples were detected with 100% accuracy and no cross-amplification.

Results: For *S. mansoni*, 22 (21%) of the samples were positive while 15 (14%) of the samples were negative via PCR. For *S. haematobium*, 7 (7%) of the samples were positive while 15 (14%) of the samples were negative. Dual infections were found in a higher percentage with 60 (58%) of the samples.

Conclusion: We have justified that PCR is more sensitive and specific by amplifying species-specific cell-free repeat DNA fragments from the same urine sample than standard methods of processing stool and urine.

INTRODUCTION

- **Schistosomiasis** is a waterborne and bloodborne parasitic disease caused by blood parasites, called schistosomes.[1]
- Two main species of Schistosomes that cause human schistosomiasis are *S. mansoni* and *S. haematobium*.
- Human schistosomiasis is highly prevalent, with 220 million people currently infected worldwide.[2]
- Predominantly distributed in sub-Saharan Africa, South America, East Asia, and Middle East.[3]
- Considered a disease of poverty, due to the lack of adequate infrastructure in the endemic countries.

IMPORTANCE OF SENSITIVE DIAGNOSTICS

- ***Kato-Katz*** (KK – Parasitological test): fecal smear on slide to look for parasite egg.[4]
  Low sensitivity and **High specificity**
- ***Circulating Cathodic Antigen*** (CCA – Antigen capture test): captures parasite antigen from urine on reagent strip.
  Low sensitivity and **Low specificity**
- ***Polymerase Chain Reaction*** (PCR – Molecular test): detects parasite DNA in urine or DNA in fecal matter.
  High sensitivity and **High specificity**

OBJECTIVE

Determine the efficacy of detecting single or dual Schistosome parasites from filtered human urine samples collected in Tanzania by amplifying species-specific cell-free repeat DNA fragments via polymerase chain reaction (PCR).

RESEARCH WORKFLOW

- The volunteers for this study are from the village of **Kayenze in Tanzania, Africa**.
- 350 participants were examined for Schistosomiasis, leading to 104 total positive samples.
- Urine, serum, and plasma samples were collected from each volunteer.
- Kato-Katz via Microscopy, urine dipstick, and POC-CCA testing were done on site.

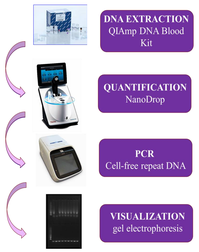

Fig 2: Research Workflow.

RESULTS

Table 1: PCR results for *S. mansoni* and *S. haematobium* individually.

Species	PCR +	PCR –
S. mansoni	**82 (79%)**	22 (21%)
S. haematobium	67 (64%)	37 (36%)

- *S. mansoni* is more prevalent than *S. haematobium* in the samples collected from Tanzania.
- All samples were identified with 100% specificity without any cross amplification.

Table 2: Comparative analysis of single and dual Schistosome infection.

S. haematobium PCR \ *S. mansoni* PCR	Count	0	1	Total
	0	15 (14%)	22 (21%)	37
	1	7 (7%)	**60 (58%)**	67
	Total	22	82	**104**

- **60% of the samples** were positive for both *S. mansoni* and *S. haematobium*.
- *S. mansoni* is more prevalent (22%), whereas *S. haematobium* is only 7% prevalent.

RESULTS CONT.

Table 3: Comprehensive analysis of Schistosome infection for both genders and for three age groups.

Schistosome species	Gender		Age group		
	Male	Female	A (17-30yrs)	B (31-50yrs)	C (51-97yrs)
S. mansoni	28 (27%)	**54 (52%)**	26 (25%)	**36 (35%)**	19 (18%)
S. haematobium	24 (23%)	**43 (41%)**	20 (19%)	**29 (28%)**	17 (17%)

- Females are more likely to be infected with both Schistosome species, *S. mansoni* (52%) and *S. haematobium* (43%) than males.
- The age group most vulnerable to Schistosome infection consists of 31-50 years old.

CONCLUSIONS

- We have identified Schistosome species-specific repeat DNA fragments, allowing differentiation between *Schistosoma* species.
- The prevalence of *S. mansoni* is predominant, although the chances of having a concurrent infection is higher.
- Schistosome infections are more prevalent in females than males for both species.
- The infection level is higher for middle age group for Schistosome species.
- The detection of species is important as both affect different body systems and can cause concurrent infections.
- We have justified the need for a more accurate and sensitive testing method to identify infected patients.

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