Infection With Strongyloides Stercoralis Among Children In Urban Slums Of Kibera In Nairobi, Kenya

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Summary

BACKGROUND

Strongyloidiasis* is an intestinal parasitic infection with poorly-defined geographical *Endemicity* in Africa. It is a Soil-Transmitted *Helminths* (STH) infection caused by *Strongyloides stercoralis* and *Strongyloides fuelleborni.

AIM

To investigate the prevalence of *Strongyloides* infection among children living in an urban slum in Nairobi, Kenya. Likewise, to assess it's association with other soil - transmitted *Helminths.*

METHODOLOGY AND FINDINGS

We used the recently-developed Ss-NIE-1-antibody ELISA assay for *Strongyloides* to evaluate *Sera* **collected during a 2012 study of Soil Transmitted *Helminth* infection prevalence among children in the Kibera slum of Nairobi, Kenya. A total of 745 samples from School Age Children (SAC) and Pre-school-age children (PSAC) were tested; eight (1.1%) were positive for *Strongyloides.* Infection was equally common among SAC and PSAC. No association was found between infection with *Strongyloides* and infection with other Soil Transmitted *Helminths.***

CONCLUSION

***Strongyloides* is a rare infection among children living in the urban slum of Kibera. Similar evaluation of exposure to *Strongyloides stercoralis* across different age groups and environmental, geographical features in Africa are warranted.**

Keywords: *Strongyloides,* children, Kenya

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Introduction

Strongyloidiasis is a Soil-Transmitted *helminth* (STH) infection caused by *Strongyloides stercoralis* and *Strongyloides fuelleborni*. It is estimated to infect 30–100 million people globally, most in tropical and subtropical countries [1].

Its prevalence is underestimated in many countries because the infection is often asymptomatic or causes nonspecific gastrointestinal symptoms [2].

Similarly,in healthy persons, *Strongyloides spp.* infection can cause abdominal pain and intermittent or persistent diarrhea.

However, in immune-compromised persons, hyper-infection(uncontrolled replication) may occur, leading to dissemination and death if left untreated [3].

Diagnosis of *Strongyloides spp.* infection may be determined through direct examination of stool specimens for larvae and/or by stool culture.

However, these methods are insensitive for *Strongyloides spp.* detection. For these reasons, *serology* is often used to evaluate exposure to *Strongyloides spp.* infection [4,5] [6].

Although, other STHs infections (including with Ascaris, *Trichuris,* and hookworms) are prevalent in both rural and urban areas in Kenya. There is little data on the prevalence of *Strongyloides* infection [7,8].

Furthermore, most studies on *Strongyloides* infection in Kenya have used low-sensitivity diagnostic methods and have taken place primarily in rural areas [1,9-12].

Methodology

Study Site

Kibera is characterized by high population, Semi-Permanent housing, and lack of official City water or sewage services [8].

Approximately 40% of PSAC and SAC were found to be infected with *Ascaris, Trichuris,* or hookworms during the 2012 study. No evaluation for *Strongyloides* infection was done at that time.

In this study, we used banked *Sera* from the 2012 study to evaluate exposure to *Strongyloides* infection among children in Kibera. Measured using a newly-developed Ss-NIE-1 ELISA assay, and evaluated for association with other STH infections

Sample testing was carried out at the Eastern and Southern Africa Centre for International Parasite Control (ESACIPAC) laboratories. [14].

This study was approved by both the Institutional review boards of the Kenya Medical Research Institute (KEMRI) and the Center for Disease Control and Prevention (CDC) organizations.

Sample Testing

In 2012, we evaluated infections with *Ascaris, Trichuris*, hookworms, as well as nutritional markers and *anthropometry* among School-Age Children (SAC) (5 – 14 years) and Pre-school Age Children (PSAC) (6–59 months) residing in the urban slum of Kibera, Kenya.

Blood samples collected during the study were centrifuged for 10 minutes at 4º C at *3000 rpm* and *plasma* stored at – 80º C before use in this study. The Ss-NIE-1 ELISA was performed as described previously [14].

Briefly, IgG4-specific ELISA was performed using plates coated with *0.3ug/ml* of recombinant protein Ss-NIE-1, prepared at CDC-Atlanta.

Subsequently, *100ul* of sample diluted at 1:50 using PBS-Tween-Milk (1X PBS/0.3% Tween/5% milk) was added per well and shaken for 30 min at 800 *rpm*.

Plates were washed four times using *200ul* of PBS-Tween-Milk, and *100ul* of 1:1000 horseradish-peroxidase-labeled mouse anti-human IgG4 (clone HP6025)(Southern Biotech, Birmingham, AL) antibody diluted in PBS-Tween was added.

The plates were then shaken again at *800 rpm* for 30 minutes and washed four times. This was followed by additional *100ul* of SureBlue *Tetramethylbenzidine* (TMB) Microwell Peroxidase Substrate (KPL, Gaithersburg, Maryland) and shaken for 5 minutes.

Finally, *100ul* of stop solution (1N sulfuric acid) was added and a plate was read using Biotek instrument ELX800UV at *450nm* using Gen5 v.2.01 software.

For each plate, controls of decreasing concentration were used to develop a standard curve for internal quality control. A strong positive *(50ug/ml)*, weak positive *(5ug/ml),* and negative control were also incorporated in every plate to monitor plate-to-plate variation. Samples with absorbance >0.180 were considered positive.

All positive samples and 10% of negative samples were retested, those with discordant results were tested a third time, as a 'tie-breaker,' before final results were recorded finally.

Prevalence of infection with different *helminths* was compared using a *chi-square* or, where appropriate, Fisher's exact test.

Results

Sera and demographic and STH infection data were available for a total of 745 PSAC (n=210) and SAC (n=535). Of those 745, eight (1.1%) tested positive by Ss-NIE-1 ELISA, including two (0.95%) PSAC and six (1.1%) SAC.

There was no association detected between infection with other STHs and exposure to *Strongyloides*.

Two (0.77%) of 260 children infected with other STH tested positive for *Strongyloides*, compared to six (1.2%) of 485 children without evidence of other STHs infections (p=0.56). ***(Table 1)***.

Table 1. *Number and percent of children positive for Strongyloides by NIE-ELISA, and for other STH infections by triplicate Kato-Katz*

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	All children	PSAC only	SAC only	
Infection type	**(N=745)**	**(N=210)***	**(N=535)**	**p-value**
Strongyloides	8 (1.1%)	2 (0.95%)	6 (1.1%)	1.000
Any STH	260 (34.9%)	75 (35.7%)	185 (34.6%)	0.77
Trichuris	169 (22.7%)	42 (20.0%)	127 (23.7%)	0.27
Ascaris	151 (20.3%)	47 (22.4%)	104 (19.4%)	0.37
Hookworm	1 (0.13%)	0 (0.0%)	1 (0.19%)	1.000
Strongyloides / Other STH Co-infection	2 (0.24%)**	0 (0.0%)	2 (0.37%)	1.000

**Includes 19 infants (6-11 months of age)*
***One SAC with Strongyloides and Ascaris co-infection and one SAC with Strongyloides and Trichuris co-infection. No PSAC were co-infected.*

Table 2.: Characteristics Of Strongyloides-Positive Vs Strongyloides ¬ -Negative Children In Kibera, Kenya, 2012.

Characteristics	*Strongyloides-positive (n=8)*	*Strongyloides-negative (n=737)*	*p*
Mean, Median Age, Years (Range)	*10.3, 11.8 (3.8-14.5)*	*8.9, 9.7 (0.49-14.9)*	*0.38**
Female	*3 (40.0%)*	*389 (52.2%)*	*0.49*

**Using ANOVA test to compare means*

There was no association between school-age status and exposure to *Strongyloides* or infection with any other STH ***(Table 1).***

Three children (40.0%) testing positive for *Strongyloides* exposure were female, compared to 389 (52.2%) testing negative (p=0.49) ***(Table 2).***

The median age of *Strongyloides*-exposed children (11.8 years) was non-significantly higher than that of unexposed children (9.7 years) ***(Table 2)***. Of the 75 negative samples retested, none were positive.

Discussion

Information about the global prevalence of *Strongyloide*s and its association with other STHs is largely absent.

Although, *Strongyloides* infection is often associated with rural, agricultural settings, it has also been found in urban and peri-urban settings in Africa, South America, and Asia [15-17].

Urban slums are more affected with *Strongyloides* than other urban areas [1].

Our study indicates that *Strongyloides* exposure is rare among children in Kibera. This contrasts with our previous data documentation of 40% prevalence of other STHs infections in the same children [13].

We found no association between infection with other STHs and exposure to *Strongyloides*. This indcates that, in this setting, one cannot be used as a proxy for the other. Children exposed to *Strongyloides* were unsignificantly older than uninfected children.

This may reflect on an increasing risk for exposure to *Strongyloides* with age, as demonstrated in previous studies [1].

However, a primary limitation of our study was the low number of children found to be exposed to Strongyloides and therefore conclusions about association with other STH infections should be interpreted with caution.

Conclusion

This study demonstrates an initial application of the new Ss-NIE-1 ELISA for detection of exposure to Strongyloides among children in an urban Kenyan slum. Infection with other STH does not necessarily indicate exposure to Strongyloides. Further studies in the same area among persons of different age groups and in surrounding areas should be done to expand our knowledge of Strongyloides infection in Kenya and globally.

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