Schistosoma haematobium Egg Excretion does not Increase after Exercise: Implications for Diagnostic Testing

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Abstract. Children are frequently invited to exercise before micturition, as it is believed that this activity will result in higher Schistosoma haematobium egg excretion, and hence, increases sensitivity of microscopic diagnoses. However, the evidence of this recommendation is scant. In the study presented here, 257 children, aged 2–15 years from south Côte d’Ivoire, provided urine samples for microscopy on consecutive days; one sample without prior exercise and one sample after exercise. Comparing the same individuals without and with prior exercise, sample positivity for S. haematobium (25.7% versus 23.0%, P = 0.31) and mean egg counts (10.2 eggs/10 mL versus 8.5 eggs/10 mL, P = 0.45) did not differ. Exercise before urine collection does not appear to increase S. haematobium egg excretion.

INTRODUCTION

Schistosomiasis is a neglected tropical disease affecting roughly 250 million people worldwide, with African settings representing 90% of the global burden of this disease.1,2 Schistosoma haematobium, one of the three main species causing schistosomiasis, affects the genitourinary system and is associated with considerable morbidity from pelvic pain, hematuria, anemia, infertility,3,4 the potential for increased risk of human immunodeficiency virus acquisition,5 and mortality from bladder cancer.4,6 The diagnosis of S. haematobium typically involves directly visualizing eggs by microscopy through standardized procedures7,8 or indirectly via evaluating individuals for hematuria.9,10 Both methods lack sensitivity, particularly when infection intensities are low. More sensitive diagnostic techniques for S. haematobium exist, such as serology, polymerase chain reaction (PCR), and schistosome circulating anodic antigen (CAA) testing.11–13 but these require sophisticated laboratory equipment, which are usually not widely available in resource-constrained settings.

Children in S. haematobium-endemic countries are frequently invited to perform a brief bout of exercise, such as jumping jacks, hoping up and down, or running up and down stairs before providing a urine specimen for the detection of S. haematobium eggs using microscopy (Figure 1). The underlying rationale is that such exercise results in higher egg excretion in the urine, and hence, may increase diagnostic sensitivity of microscopy. Indeed, this practice is embedded in the World Health Organization (WHO) guidelines,14 which state that “physical exercise combined with fluid intake has been shown to significantly increase egg output; it is therefore useful to ask the schoolchildren to do some short physical exercise before collecting the urine specimens”. However, the evidence based on this recommendation is scant. We sought to evaluate the utility of physical exercise before urine collection on S. haematobium egg excretion in a community-based study in a primarily rural area of Côte d’Ivoire.

METHODS

We performed a cross-sectional study in six villages in the Azaguié region, south Côte d’Ivoire, located about 40 km north of the country’s economic capital Abidjan. According to a recent national school-based survey, S. haematobium affects an estimated 5.3% of children in Côte d’Ivoire.15 The current research was conducted in August 2015 as part of a larger epidemiologic study. The purpose and procedures of the study were explained to the village and local health authorities. Ethical approval was obtained from the Ministry of Health and Public Hygiene of Côte d’Ivoire (CNER; reference no. 037/MSLS/CNER-dkn, approved July 22, 2015). Written informed consent from parents or guardians and oral assent from children was obtained before enrollment. All data were coded and entered into an Excel folder (Microsoft Corp., Redmond, WA). After completion of the study, all participants received a single 40 mg/kg oral dose of praziquantel at no cost, as per the national protocol.

Overall, 329 children aged 2–15 years (mean 6.8 years) were invited to provide midstream urine samples on two consecutive days. Urine was collected between 10:00 and 14:00 hours and processed by the filtration technique, adhering to standard protocols.7,8 Children were asked to provide a urine sample without prior exercise on the first day of the study and after exercise on the second day of the study. Exercise consisted of performing 20 “jumping jacks” for children aged 5 years and above. Children under the age of 5 years would have a parent or guardian holding them and gently lifting them up and down 20 times to mimic a jumping or bouncing motion. This exercise was conducted no earlier than 10:00 hours and the subsequent urine sample was collected.

Urine samples were transferred to a regional laboratory and processed the same day. In brief, 10 mL of urine was extracted...
paired individuals on days 1 and 2, and a Wilcoxon signed-rank and increase mean egg counts in paired aged 5 children (McNemar procedures were conducted on both days of the study. were reexamined by a senior laboratory technician. These eggs was recorded. For quality control, 10% of all slides before microscopy. Slides were examined under 10× and 40× lenses (Olympus Schweiz AG, Volketswil, Switzerland) and the presence, and if applicable, the number of S. haematobium eggs was recorded. For quality control, 10% of all slides were reexamined by a senior laboratory technician. These procedures were conducted on both days of the study. McNemar’s test was used to evaluate test positivity between individuals on days 1 and 2, and a Wilcoxon signed-rank and paired t tests were used to compare egg counts in individuals with and without exercise.

RESULTS

Of the 329 children invited to participate in the study, 257 (78.1%) provided a urine sample on both days and were included in the final analysis. There were more males (N = 157, 61.1%) and most of the children were over 5 years of age (N = 163, 63.4%). On day 1 (without exercise), 66 of 257 samples (25.7%) were S. haematobium-positive, whereas on day 2 (after exercise), 59 of 257 (23.0%) were found positive (McNemar’s P value: 0.31). Exercise before micturition did not increase mean egg counts in paired t tests comparing all children (P = 0.45), children aged < 5 years (P = 0.31), children aged 5–15 years (P = 0.80), among females (P = 0.92), or only among males (P = 0.19) (Table 1). The Wilcoxon signed-rank testing yielded similar P values, with none below 0.1. Figure 2 shows paired egg counts for individuals with and without exercise before urine collection.

DISCUSSION

Schistosomiasis continues to be a major cause of morbidity in Africa despite ongoing efforts to curb this infection. Innovations to increase diagnostic sensitivity of existing tests, especially in low-intensity infections, are necessary for regional control and elimination strategies. Highly sensitive diagnostic tools, such as serologic assays, PCR testing, and CAA detection, are unfortunately not yet widely available for control and elimination programs in the most affected regions. Simple, effective, and inexpensive methods that can be used at the point-of-care with high diagnostic sensitivity would be very useful in the interim, whereas newer diagnostic methods are slowly implemented in endemic settings. Indeed, the discovery of circadian variations of S. haematobium egg excretion in the urine provides an example of how this biologic trait can be harnessed to increase diagnostic sensitivity, resulting in large-scale policy changes on how and when (i.e., mid-day) urine is collected. Exercise before micturition has been included in guidelines as a potential method of increasing S. haematobium egg excretion. However, to our knowledge, the one published study evaluating the relationship between exercise and urine egg excretion included only seven school-aged boys, four of whom conducted exercise in addition to ingesting 350 mL of fluid before providing a urine sample. This was part of a larger study involving 24 school-aged boys evaluating day-to-day and circadian variation in S. haematobium egg output in urine. This study demonstrated that the four children who exercised had greater egg outputs compared with three children who did not, at different times of the day. Exercise in this study consisted of running 800 m and conducting 10 push-ups, 45 minutes before providing a urine sample. Our study did not find any association between exercise before micturition and S. haematobium egg output in a sample population much larger than the prior study (257 children with complete data records). In addition, we did not find any association between S. haematobium egg outputs after exercise in different age groups or sexes. Our findings suggest that exercise before micturition does not increase S. haematobium egg outputs in urine and may not be a useful recommendation to increase diagnostic sensitivity. There are potential weaknesses of this study that may contribute to not finding an association between exercise and egg excretion with or without jumping before providing a urine sample.

<table>
<thead>
<tr>
<th>Demographic</th>
<th>N (%)</th>
<th>Mean egg concentration* (no exercise)</th>
<th>Mean egg concentration* (with exercise)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>257 (100)</td>
<td>10.2</td>
<td>8.5</td>
<td>0.45</td>
</tr>
<tr>
<td>Age 2–4 years</td>
<td>94 (36.6)</td>
<td>6.4</td>
<td>3.1</td>
<td>0.31</td>
</tr>
<tr>
<td>Age 5–15 years</td>
<td>163 (63.4)</td>
<td>12.4</td>
<td>11.7</td>
<td>0.80</td>
</tr>
<tr>
<td>Female</td>
<td>100 (38.9)</td>
<td>8.8</td>
<td>9.2</td>
<td>0.92</td>
</tr>
<tr>
<td>Male</td>
<td>157 (61.1)</td>
<td>11.1</td>
<td>8.1</td>
<td>0.19</td>
</tr>
</tbody>
</table>

*Egg concentration, defined as eggs per 10 mL of urine.

Figure 1. Children performing exercise before providing a urine sample by running up and down a ramp, in the Azaguié region, Côte d’Ivoire. This figure appears in color at www.ajtmh.org.
S. haematobium egg excretion in urine. First, to isolate the effects of exercise, we did not specifically promote 350 mL of fluid intake before micturition as was done by Doebring et al. In our collective experience, fluid ingestion before micturition is not a widely used practice to increase S. haematobium egg excretion, and hence, was not included in our protocol. Second, the exercise conducted in our study consisted of 20 jumping jacks (or 20 gentle “bounces” in those under 5 years of age), which may be less vigorous compared with the exercise conducted in prior studies. Perhaps greater exercise intensity could result in greater S. haematobium egg excretion. Last, our study design would be stronger had we used a randomized cross-over block design, such that children would provide urine samples on two consecutive days, but some children would exercise on the first day and others would exercise on the second day. The reason this protocol was not used (as was our initial intention) was due to concerns based on earlier observations that when some children performed exercise, then others would as well, even if they were not randomized to do so. Such deviation from randomization could mask any potential impact of our intervention.

Taken together, exercise before micturition is a common behavioral practice in African settings as it is believed to help increase S. haematobium egg excretion and diagnostic sensitivity of microscopy, and hence, is being recommended in the WHO guidelines. We did not find an association between S. haematobium egg excretion and exercise in this study and doubt whether this practice improves the sensitivity of S. haematobium diagnoses. However, future studies evaluating the link between exercise and S. haematobium egg excretion may be required to draw definitive conclusions.

REFERENCES

16. Lo NC et al., 2017. A call to strengthen the global strategy against schistosomiasis and soil-transmitted helminthiasis: the time is now. Lancet Infect Dis 17: e64–e69.


