Schistosomiasis among Recreational Users of Upper Nile River, Uganda, 2007

Oliver W. Morgan, Gary Brunette, Bryan K. Kapella, Isabel McAuliffe, Edward Katongole-Mbidde, Wenkai Li, Nina Marano, Sam Okware, Sonja J. Olsen, W. Evan Secor, Jordan W. Tappero, Patricia P. Wilkins, and Susan P. Montgomery

After recreational exposure to river water in Uganda, 12 (17%) of 69 persons had evidence of schistosome infection. Eighteen percent self-medicated with praziquantel prophylaxis immediately after exposure, which was not appropriate. Travelers to schistosomiasis-endemic areas should consult a travel medicine physician.

Schistosomiasis, a parasitic infection caused by schistosome flukes, affects 207 million persons worldwide, mostly in sub-Saharan Africa (*1*). Schistosomiasis has been reported among travelers (*2*–*12*); 3 outbreaks have been reported among white-water rafters on the Omo River in Ethiopia (*2*,*7*,*10*). During September–November 2007, the Centers for Disease Control and Prevention (CDC) received reports of schistosome infection among travelers returning from white-water rafting on the Nile River, Jinja District, Uganda. Approximately 12,000 persons raft each year in Uganda, and local rafting companies believe that exposure to fast-moving white water during rafting and kayaking presents a low risk for schistosomiasis (C. McLeay, pers. comm.).

The Study

During November 30–December 5, 2007, we enrolled a convenience sample of competitors and spectators attending the international Nile Freestyle Festival kayaking event and tourists on commercial rafting trips in Jinja District, Uganda. We administered a questionnaire to collect information about participants' demographic characteristics, use of praziquantel (the antiparasitic drug treatment for schistosome infection), and exposure to fresh water. Three months after enrollment, we asked study participants who had had a negative or indeterminate result from a blood test for schistosome antibodies at the time of enrollment to complete an Internet-based questionnaire about freshwater exposures, health symptoms, and medical tests or treatments for schistosomiasis since enrollment.

We measured infection by collecting two 5-mL blood samples 3 months apart and testing them for evidence of schistosome antibody seroconversion. We tested for presence of schistosome-specific antibodies using an ELISA assay screening test that is 99% sensitive for *Schistosoma mansoni* and 90% sensitive for *S. hematobium* (*10*). We confirmed FAST-ELISA–positive samples using an *S. mansoni*–specific immunoblot to detect species-specific antibody. We tested all samples using an *S. hematobium*–specific immunoblot, which is 95% sensitive and 99% specific for each species (*13*). We defined a positive test result as positive results by both tests, an indeterminate result as positive by FAST-ELISA but negative by immunoblot, and a negative result as negative by both tests.

We defined study participant exposures from 2 weeks before enrollment until second sample collection by 4 activity categories: no water-contact activity, swimming/wading only, kayaking/rafting only, and swimming/wading plus kayaking/rafting. We defined schistosome antibody seroconversion in participants as either being first-test–negative and second-test–positive, or being first-test–negative and second-test–indeterminate. We compared characteristics between groups using the χ^2 test for categorical data and the Mann-Whitney test for continuous variables (*14*). We expressed the risk for infection as the proportion of persons in each activity category who had evidence of schistosome antibody seroconversion and calculated the Mantel-Haenszel χ^2 test for trend (*14*). We performed all analyses using SAS version 9.1 (SAS Institute, Cary, NC, USA). The CDC Institutional Review Board and the Uganda Virus Research Institute approved this study.

We enrolled 150 study participants; 2 subsequently withdrew. Thirty-five (24%) participants were not followed up because their first blood test was positive; all of these persons reported previous exposure to fresh water in schistosomiasis-endemic countries. Of the remaining 113 persons eligible for follow-up, 69 (61%) provided a second blood sample. Persons who provided only 1 blood sample were more likely to be younger ($p = 0.005$) and female ($p = 0.03$) (Table 1).

Of 69 persons followed up, 23% had fever, 13% cough, 10% skin rash, and 10% abdominal pain; 8% reported prickling skin. None reported physician-diagnosed acute schistosomiasis. Twelve (17%) of the 69 persons with 2 blood samples had evidence of seroconversion. No

Author affiliations: Centers for Disease Control and Prevention, Atlanta, Georgia, USA (O.W. Morgan, G. Brunette, B.K. Kapella, I. McAuliffe, W. Li, N. Marano, S.J. Olsen, W.E. Secor, J.W. Tappero, P.P. Wilkins, S.P. Montgomery); Ugandan Virus Research Institute, Entebbe, Uganda (E. Katongole-Mbidde); and Ministry of Health, Kampala, Uganda (S. Okware)

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Table 1. Characteristics of 113 recreational users of the upper Nile River who participated in a study to determine risk for schistosome infection, were eligible for study follow-up, and provided 1 or 2 blood samples, Uganda, 2007*

Characteristic	Provided 1 blood sample, no. (%), n = 44	Provided 2 blood samples, no. (%), n = 69	p value†
Male sex	14 (32)	34 (50)	0.03
Main reason for being at the Nile			
Rafter	20 (45)	32 (46)	0.4
Spectator at the competition	12 (27)	18 (26)	
Kayak competitor	9 (21)	8 (12)	
Other	3 (7)	11 (16)	
Region of residence			
Africa	6 (14)	16 (23)	0.6
Americas	12 (27)	16 (23)	
Europe	15 (34)	17 (25)	
Australasia	7 (16)	12 (17)	
None given	4 (9)	8 (12)	

*Median ages (ranges) of study participants were as follows: 1 blood sample provided: 25 y (18–41 y); 2 blood samples provided, 29 y (16–67 y); p = 0.005.
†p values estimated by using the Mann-Whitney test for age and a χ^2 test for all other variables.

seroconversions were identified among the 9 persons who reported no water-contact activities. Serologic data suggested that infection occurred in 1 (13%) of 8 reporting swimming/wading only; 4 (15%) of 26, kayaking/rafting only; and 7 (27%) of 26, swimming/wading plus kayaking/rafting (Table 2).

Of 106 persons for whom data were recorded, 19 (18%) reported self-medicating with praziquantel while at the kayaking competition. Of the 12 participants with evidence of seroconversion, 6 had data recorded about self-medication, none of whom took praziquantel.

Conclusions

Approximately one fifth of persons with recreational exposure to water on the upper Nile River in Jinja District showed evidence of schistosome antibody seroconversion. Infection occurred among persons who reported swimming/wading only, kayaking/rafting only, and both activities, which refutes the belief that exposure to fast-moving water presents a low risk for schistosomiasis.

Exposure to schistosomes is likely to be highest in slow-moving water near riverbanks; thus, persons who go rafting may be at highest risk while putting their kayaks/rafts into and taking them out of the river. Although we were unable to estimate the risk for infection attributable to fast-moving white-water exposure alone, we did find that persons who reported swimming/wading and kayaking/rafting had the highest risk, possibly because of increased duration of exposure (*4*).

Table 2. Proportion of recreational users of the upper Nile River who had schistosome infection, Uganda, 2007*

Activity	No. infected/total (%)
No water-contact activity	0/9
Swimming/wading only	1/8 (13)
Kayaking/rafting only	4/26 (15)
Kayaking/rafting and swimming/wading	7/26 (27)
All study participants	12/69 (17)

*Activity categories are mutually exclusive. χ^2 test for trend p = 0.06

Eighteen percent of study participants reported self-medicating with praziquantel immediately or shortly after river water exposure. However, they would not have been protected against schistosomiasis because praziquantel acts against mature schistosome parasites and thus is most effective if taken after the parasite has developed to the adult stage, which is 4–6 weeks after infection. Local advice about using praziquantel to prevent schistosomiasis may not be appropriate; because indigenous populations have ongoing exposure, timing of treatment is not as critical. Travelers with discrete freshwater exposures in schistosomiasis-endemic countries should consult a travel medicine physician. In addition, information could be made available to pharmacies, rafting companies, and travelers about when to take praziquantel.

Our study had several limitations. The study cohort was a convenience sample, and participants might not have had equal chance of being enrolled. Use of this sample may have introduced bias, although whether any such bias would contribute to overestimation or underestimation of risk is unclear. Because schistosome antibody tests do not differentiate newly acquired infection, we excluded persons with first-test–positive results from the study follow-up. However, if these persons were more likely to have had a higher risk for infection, excluding them would have led us to underestimation risk for infection.

More than 12,000 persons take rafting trips in Uganda each year. Many travelers do not follow advice to avoid freshwater activities in schistosomiasis-endemic countries (*15*). Travelers should be made aware that white-water exposure presents a risk for schistosomiasis and that treatment with praziquantel should be at least 4–6 weeks after last exposure, preferably under the direction of a travel medicine physician.

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Dr Morgan is an epidemiologist in the Division of Emerging Infections and Surveillance Services, National Center for Emerging and Zoonotic Infectious Diseases (proposed), CDC. His primary research interest is the global epidemiology of respiratory diseases.

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Address for correspondence: Oliver W. Morgan, Centers for Disease Control and Prevention, Mailstop C12, 1600 Clifton Rd NE, Atlanta GA 30333, USA; email: omorgan@cdc.gov

Appendix Table. Persons and public health agencies assisting with the collection of follow-up blood samples in a study of schistosome infection among recreational users of the upper Nile River, Uganda, 2007*

Name	Public health agency
United States	
Sue Jenkerson	Alaska Department of Health and Social Services
Jane Conard	Mat-Su Public Health Center
Kanta Sircar	Los Angeles County Department of Public Health
Amy Karon	California Department of Public Health
Duc Vugia	California Department of Public Health
Douglas Hatch	California Department of Public Health
Frank Alvarez	Santa Barbara County Public Health Department
Paige Batson	Santa Barbara County Public Health Department
Ken Gershman	Colorado Department of Public Health
Kate Lujan	Colorado Department of Public Health
Alice Guh	Connecticut Department of Health
Paul Melstrom	Georgia Department of Human Resources
Laurel Garrison	Georgia Department of Human Resources
Randy Nett	Idaho Department of Health and Welfare
Kathy Reynolds	Southeastern District Health Department
Alfreda DeMaria	Massachusetts Department of Public Health
Patricia Kludt	Massachusetts Department of Public Health
Kathleen Gilmore	Massachusetts Department of Public Health
Steven Helgersen	Montana Department of Public Health and Human Services
Ellen Leahy	Montana Department of Public Health and Human Services
Shelly Meyer	Montana Department of Public Health and Human Services
Vivian Mears	New Hanover County Health Department
Myra Brinson	Raleigh State Laboratory
Ning An	Oregon Department of Human Services
Emilio Debess	Oregon Department of Human Services
Susan Donnelly	Hood River Health Department
John Dunn	Tennessee Department of Health
John Su	Texas Department of State Health Services
Thi Dang	Texas Department of State Health Services
Canada	
Diane MacDonald	Public Health Agency of Canada
Denise Werker	Public Health Agency of Canada
Glennis Doiron	Calgary Laboratory Services
Muhammad Morshed	British Colombia Centre for Disease Control
Laura MacDougall	British Colombia Centre for Disease Control
James Aw	Medcan Clinic, Ontario
Beth Swift	Medcan Clinic, Ontario
Australia	
Anthony Moore	Health Protection Service, ACT Health
Riemke Kampen	Health Protection Service, ACT Health
Tiffany Savli	ACT Pathology, ACT Health
Jeremy McAnulty	Communicable Diseases Branch, New South Wales
Hanisah Corner	Center for Epidemiology and Research, New South Wales
Rogan Lee	Westmead Hospital, New South Wales
Christine Selvey	Communicable Diseases Branch, Queensland Health
Avner Misrachi	Department of Health and Human Services, Tasmania
David Coleman	Department of Health and Human Services, Tasmania
Margaret Hill	Department of Health and Human Services, Victoria
Megan Scully	Western Australia Department of Health
New Zealand	
Simon Baker	Auckland Regional Public Health Service
Don Bandaranayake	Population Health Directorate, Ministry of Health
Alistar Humphrey	Canterbury District Health Board
Ramon Pink	Canterbury District Health Board
Jill Geary	Canterbury District Health Board
Belinda Loring	Toi Te Ora Public Health Board
Anita Bell	Waikato District Health Board
Daphne Fairfood	Diagnostic Medlab Limited
Europe	
Tizza Zomer	Swedish Institute for Infectious Disease Control, Sweden
Esther Kissling	Institut Scientifique de Santé Publique, Belgium
Sabrina Bacci	Statens Serum Institut, Denmark
Kaisa Mäkinen	Lapland Central hospital, Finland
Laura Pakarinen	National Public Health Institute, Finland
Gudrun Bettge-Weller	Fachgebiet Infektiologische Diagnostik, Germany

Anja Hauri	Hesse State Health Office, Germany
Joan O'Donnell	HSE–Health Protection Surveillance Centre, Ireland
Tone Brunn	Norwegian Institute of Public Health, Norway
Christina Furtado	Instituto Nacional de Saúde Dr Ricardo Jorge, Portugal
Eugenio Cordeiro	Administração Regional de Saúde do Centro, Portugal
Kitty Smith	Health Protection Scotland, Scotland
Titia Kortbeek	Netherlands Laboratory for Infectious, Netherlands
Praveen Sebastianpillai	Health Protection Agency, England
Jane Jones	Health Protection Agency, England
Lorenzo Pezzoli	Health Protection Agency, England
Richard Pebody	European Programme for Intervention Epidemiology Training, European Centre for Disease Prevention and Control
Viviane Bremer	European Programme for Intervention Epidemiology Training, European Centre for Disease Prevention and Control

*ACT, Australian Capital Territory; HSE, Health Service Executive.