Hygienic Behaviors and Risks for Ascariasis among College Students in Kabul, Afghanistan

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Abstract. Teenagers have a high prevalence of ascariasis in low-income countries with endemic disease, and their hygienic behaviors and access to proper sanitation may be limited in rapidly urbanizing settings. We studied university students in Kabul to estimate the proportion with ascariasis and determine the prevalence of risk factors for infection. Ascariasis was assessed through microscopy for 520 students attending Kabul Medical University. Overall, 15.8% of students were infected. Living in a hostel (21.2% versus 10.4% in houses) using well water (27.7% versus 9.7% for piped water), eating street food (29.4% versus 3.0% for those who do not), and eating unwashed vegetables (63.6% versus 8.8% for those who do not) were risk factors for infection. Recent city migrants who live in group hostels, including students, are important targets for interventions to reduce ascariasis. Such interventions could include encouraging individuals to prepare their own food and use only potable water.

INTRODUCTION

An estimated 0.8–1.2 billion people worldwide are infected with the parasite *Ascaris lumbricoides*,¹ and Afghanistan reports the fourth highest national prevalence in the world at 36%.² Embryos develop in the soil from excreted ova, and are transmitted to new hosts through food or water. Most infections are asymptomatic; however, as prevalence of the disease increases in a community, the intensity of infection becomes greater,³ and individuals may exhibit symptoms such as physical wasting, anemia, intestinal blockage, bowel obstruction, diarrhea, and pneumonitis.⁴

Because ascariasis is preventable with adequate sanitation systems and regular hand washing, a greater prevalence of ascariasis in an area reflects high poverty and inadequate public health infrastructure.⁵ These factors are particularly pertinent in Afghanistan, whose Human Development Index is 0.468, the lowest of any country outside of Africa,⁶ and a poverty rate of 36.5%.⁷ The infrastructure of Afghanistan's cities has been stressed by sustained civil conflict and rapid urbanization,⁸ as economic and educational opportunities in places such as Kabul attract rural migrants.⁹

Little is known about ascariasis risk factors or the use of anthelmintics in Afghanistan, although a survey conducted in 2003 found that 57.3% of children between 8 and 15 years of age in Kabul were infected (which was higher than other areas, e.g., 27% in Nangarhar).¹⁰ Globally, ascariasis prevention focuses on the household as a primary setting for transmission and young children the highest incidence of disease, although older adolescents and young adults maintain a high prevalence of disease.^{4,11} Not having a latrine and handwashing after defecation were significantly related to ascariasis in studies of children in Delhi, India,¹² children in Northern Area, Pakistan,¹³ and tea workers in Assam, India.¹⁴

In a study of university students from Kabul, Afghanistan, we investigated how behaviors and access to sanitary

measures differed between students living in different housing conditions and who came from disparate regions of Afghanistan. We also measured the prevalence of ascariasis and identified risk factors for infection.

MATERIALS AND METHODS

Study population. Established in 1932, Kabul Medical University (KMU) contains a medical school and faculties for allied health fields. The university attracts students from all over Afghanistan, and students either live in a private household (e.g., family in the area) or in a group hostel, which can be crowded and lack proper sanitary and food preparation facilities.

Students attending KMU were selected into this cross-sectional study through a stratified, convenience sampling method. During class, students from seven faculties were approached to participate, to ensure a representative sample of the university. Twenty students were selected from each faculty from each year, so that Curative and Stomatology (5-year programs) had more students than Public Health or Nursing (4-year programs), Technology or Anesthesiology (3-year programs at the time of the study), or Midwifery (2-year programs at the time of the study). An equal number of students living in hostels and living in houses was chosen for each year in each faculty. Our sample size was calculated based on an expected ascariasis prevalence of 24% and a desired confidence interval width of 5%. With an α level of 0.05 and a design effect of 2, 524 participants would be necessary.

Microscopy. Participants provided researchers with a fresh stool sample in a sterilized specimen container. Approximately 40 mg was uniformly spread over a 20-mm distance on a slide, with a coverslip set on top. Two microbiologists, both trained in medical microbiology and each with over 10 years of laboratory experience, examined slides for the presence of *A. lumbricoides* ova through simple microscopy using a CH20 Olympus microscope (Olympus Corporation, Tokyo, Japan) at $\times 40$ magnification (0.65 aperture) at laboratories in the KMU Microbiology Department.

Statistical analysis. Significance of the bivariate associations was assessed using Pearson's χ^2 test or the Cochran–Armitage trend test. We corrected for multiple

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testing through the sequential Holm–Bonferroni method. A multivariable model was constructed with explanatory variables that had a statistically significant relationship with ascariasis in the bivariate analysis. The model specified a Poisson regression with robust variance estimation, which output estimates of prevalence ratios and 95% confidence intervals (CI). A *P* value of < 0.05 was considered statistically significant. Analyses were performed in SAS version 9.3 (SAS Institute, Cary, NC).

Ethics statement. This study was approved by the Ethics Committee at the KМУ. Participants provided a signed informed consent before enrollment. The questionnaire and informed consent documents are in the Supplemental Appendix.

RESULTS

In total, 525 students were asked to participate, and 520 completed the survey. The average age of participants was 20.7 years. Students came from 29 regions of Afghanistan with only 22.9% originally from Kabul. Demographic characteristics and hygienic practices differed by residential place (Table 1). For example, those living in hostels were

more likely to eat street food (51.2%) than those living in a house (45.8%).

Approximately 15.8% of the participants had ascariasis (Table 2). Prevalence decreased over the participant's year of study, with first-year students having higher prevalence of ascariasis (25.0%) than fifth-year students (5.0%) (*P* = 0.0014). People living in a hostel had greater prevalence of ascariasis (21.2%) than those living in a house (10.4%) (*P* = 0.008). Students eating street food and eating unwashed vegetables had higher prevalence of ascariasis than those who did not (*P* = 0.0014 for both variables). Washing hands before eating was protective against ascariasis (*P* = 0.008). Washing hands after using the toilet was also significantly associated with a lower prevalence of ascariasis (*P* = 0.008).

Table 3 shows the multivariable regression. Each additional year of study in Kabul was associated with 0.73 times the prevalence of ascariasis compared with the previous year (95% CI: 0.61, 0.88), and residing in a hostel was associated with 1.61 times higher prevalence of ascariasis compared with those living in a house (95% CI: 1.13, 2.30). Using well water, eating street food, and eating unwashed vegetables were all associated with higher prevalence of

TABLE 1
Differences in demographic characteristics or hygienic practices and residential place, Kabul, Afghanistan, 2014–2015

	Count	Living in hostel, count (%)	Living in house, count (%)	<i>P</i> value*
Overall	520	260	260	
Sex				
Male	289	172 (66.2)	117 (45.0)	0.0012
Female	231	88 (33.8)	143 (55.0)	
Province of origin				
Not Kabul	401	251 (96.5)	150 (57.7)	0.0012
Kabul	119	9 (3.5)	110 (42.3)	
Source of water				
Piped water	290	146 (56.2)	144 (55.4)	0.0012
Well water	159	80 (30.8)	79 (30.4)	
Bottled water	46	18 (6.9)	28 (10.8)	
Other	25	16 (6.2)	9 (3.5)	
Eat street food				
Yes	252	133 (51.2)	119 (45.8)	1.00
No	267	127 (48.8)	140 (53.8)	
Eat unwashed vegetables				
Yes	66	45 (17.3)	21 (8.1)	0.0120
No	453	214 (82.3)	239 (91.9)	
Wash hands before eating				
Yes	487	244 (93.8)	243 (93.5)	1.00
No	33	16 (6.2)	17 (6.5)	
Wash hands after using toilet				
Yes	437	217 (83.5)	220 (84.6)	1.00
No	82	43 (16.5)	39 (15.0)	
Need to wash hands before eating and after using toilet				
Yes	499	248 (95.4)	251 (96.5)	1.00
No	21	12 (4.6)	9 (3.5)	
Garbage for solid waste disposal				
Yes	380	191 (73.5)	189 (72.7)	1.00
No	133	64 (24.6)	69 (26.5)	
Clean toilet inside hostel				
Yes	182	101 (38.8)	81 (31.2)	0.4263
No	335	157 (60.4)	178 (68.5)	
Disinfect toilets				
Yes	160	81 (31.2)	79 (30.4)	1.00
No	359	179 (68.8)	180 (69.2)	
<i>Ascaris</i> eggs in stool				
No	438	205 (78.8)	233 (89.6)	0.0072
Yes	82	55 (21.2)	27 (10.4)	

* From Pearson's χ^2 test of independence. Adjusted for multiple testing with the Holm–Bonferroni method.

TABLE 2

Bivariate associations between demographic characteristics or hygienic practices and prevalence of *Ascaris*, Kabul, Afghanistan, 2014–2015

	Count	Ascaris eggs in stool	
		Count (%)	P value*
Overall	520	82 (15.8)	
Sex			
Male	289	47 (16.3)	1.00
Female	231	35 (15.2)	
Year of study			
1	140	35 (25.0)	0.0014
2	140	23 (16.4)	
3	120	15 (12.5)	
4	80	7 (8.8)	
5	40	2 (5.0)	
Faculty			
Curative	100	12 (12.0)	0.33
Stomatology	100	8 (8.0)	
Public Health	80	15 (18.8)	
Nursing	80	15 (18.8)	
Midwifery	40	7 (17.5)	
Technology	60	10 (16.7)	
Anesthesiology	60	15 (25.0)	
Province of origin			
Not Kabul	401	71 (17.7)	0.17
Kabul	119	11 (9.2)	
Residential place			
Hostel	260	55 (21.2)	0.0080
House	260	27 (10.4)	
Source of water			
Piped water	290	28 (9.7)	0.0014
Well water	159	44 (27.7)	
Bottled water	46	3 (6.5)	
Other	25	7 (28.0)	
Eat street food			
Yes	252	74 (29.4)	0.0014
No	267	8 (3.0)	
Eat unwashed vegetables			
Yes	66	42 (63.6)	0.0014
No	453	40 (8.8)	
Wash hands before eating			
Yes	487	70 (14.4)	0.0080
No	33	12 (36.4)	
Wash hands after using toilet			
Yes	437	59 (13.5)	0.0080
No	82	23 (28.0)	
Need to wash hands before eating and after using toilet			
Yes	499	75 (15.0)	0.17
No	21	7 (33.3)	
Garbage for solid waste disposal			
Yes	380	52 (13.7)	0.34
No	133	27 (20.3)	
Clean toilet inside residence			
Yes	182	22 (12.1)	0.34
No	335	60 (17.9)	
Disinfect toilets			
Yes	160	24 (15.0)	1.00
No	359	58 (16.2)	

* From Pearson's χ^2 test of independence for all variables except year of study, which used the Cochran-Armitage trend test. Adjusted for multiple testing with the Holm-Bonferroni method.

ascariasis. Washing hands before eating was associated with decreased prevalence of ascariasis.

DISCUSSION

A high prevalence of ascariasis is common in low-income countries; poor public health and municipal infrastructure result in limited access to sanitation and clean water,

TABLE 3

Multivariable associations between demographic characteristics or hygienic practices and prevalence of *Ascaris* eggs in stool, Kabul, Afghanistan, 2014–2015

	Prevalence ratio* (95% confidence interval)	P value
Year of study (continuous)	0.73 (0.61, 0.88)	0.0009
Live in hostel vs. house	1.61 (1.13, 2.30)	0.0089
Use well water vs. use piped water	2.18 (1.47, 3.22)	< 0.0001
Use other water vs. use piped water	1.22 (0.71, 2.09)	0.47
Eat street food (yes vs. no)	7.56 (3.73, 15.33)	< 0.0001
Eat unwashed vegetables (yes vs. no)	3.22 (2.15, 4.82)	< 0.0001
Wash hands before eating (yes vs. no)	0.38 (0.23, 0.63)	0.0002
Wash hands after using the toilet (yes vs. no)	2.08 (1.31, 3.32)	0.0021

* From Poisson regression with robust variance estimation.

inadequate hygienic practices, and greater infectious morbidity in the presence of greater population density.⁴ This study found a high prevalence of ascariasis in a university student population in Kabul, Afghanistan. Kabul is one of the five fastest growing cities in the world, and in 2015 was home to approximately 3.7 million people.¹⁵ As the population has rapidly expanded, the city has faced housing shortages and a decaying sanitary infrastructure.^{16,17} Ascariasis was particularly high among those living in hostels, or group homes, and could be explained in part through differences in hygienic behaviors: for instance, students in hostels more commonly consumed well water and unwashed vegetables. Location characteristics have been previously identified as a strong predictors of ascariasis.¹³ In Assam, India, people living in crowded households (≥ 6 people), not dissimilar to the crowded hostels we encountered, had higher prevalence of ascariasis (48.0%) than those in less crowded households (29.2%).¹⁴

About half of all students in this study regularly consumed street food—the strongest predictor of ascariasis. A study among schoolchildren in Ethiopia also found an association between eating street food and helminth infections,¹⁸ and eating or preparing street food has been linked to risk of other gastrointestinal infections, such as *Salmonella*.¹⁹ Encouraging students to prepare their own food, including lunch brought to the university, could be one simple method to reduce infections.

Limitations. This study was cross-sectional, and we were unable to evaluate temporality of these associations, including if students from outside Kabul were infected in Kabul or their home province. We also focused on university students, who as an age group are at high risk for infection, but who are likely to be economically privileged compared with young adults who are not attending university. Additionally, ascertainment of ascariasis was through microscopy, other methods such as the Kato–Katz technique and polymerase chain reaction are more sensitive and have higher negative predictive value,²⁰ and we cannot discount the possibility of miscategorizing other parasitic infections as ascariasis. The Kato–Katz stain was not available at KMU during the study period. Our outcome did not quantify the intensity of infection, which is an important predictor of the degree of illness. Our study was also limited by not collecting additional information on socioeconomic

status, previous helminth infections, concurrent parasite infections, or history of receiving anthelmintic therapy.

Conclusions. Ascariasis leads to chronic malnutrition and other serious health outcomes. In this study of university students in Kabul, Afghanistan, most of whom were recent migrants into the city, many engaged in unhygienic practices, like eating unwashed vegetables and not washing hands. Because the prevalence of positive hygienic behaviors was lower among students who lived in hostels than in houses, these dwellings can be targeted for future interventions. Encouraging students to prepare their own food, to regularly wash hands, and to not use street vendors would be important steps in reducing risk of this infection in Afghanistan. This study may also be a call to routinely screen matriculants for parasites and/or provide mass treatment with anthelmintic therapy on admission.

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