Am. J. Trop. Med. Hyg., 88(2), 2013, pp. 359–363
doi:10.4269/ajtmh.2012.12-0245

Knowledge, Attitudes, and Practices Related to Leptospirosis among Urban Slum Residents in Brazil

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Abstract. Leptospirosis disproportionately affects residents of urban slums. To understand the knowledge, attitudes, and practices regarding leptospirosis, we conducted a cross-sectional study among residents of an urban slum community in Salvador, Brazil. Of the 257 residents who were interviewed, 225 (90%) were aware of leptospirosis and more than two-thirds of respondents correctly identified the modes of disease transmission and ways to reduce exposure. However, study participants who performed risk activities such as cleaning open sewers had limited access to protective clothing such as boots (33%) or gloves (35%). Almost all respondents performed at least one activity to prevent household rat infestation, which often included use of an illegal poison. Our findings support the need for interventions targeted at the individual and household levels to reduce risk of leptospirosis until large-scale structural interventions are available to residents of urban slum communities.

INTRODUCTION

Leptospirosis is a zoonotic disease with a global distribution and is caused by infection with pathogenic spirochete bacteria from the genus *Leptospira*. Human infections primarily result after exposure to the urine of infected animals either directly or indirectly through contact with contaminated water or soil.[1] The principal reservoirs for the bacteria are rodents, cattle, swine, and canines.[2,3] Leptospirosis has a variable clinical course; ranging from a self-limiting asymptomatic infection to a life-threatening illness with severe manifestation such as pulmonary hemorrhage.[4] Leptospirosis has been recognized as an important infectious disease in developing countries and has also been recognized as a problem of urban slum communities in the major cities of Brazil and other countries.[5–8]

Typically, urban slums are densely populated and underserved by health, education, water, and sanitation services. Urban slums are composed of informal housing structures and characterized by high levels of poverty.[9] These characteristics yield high levels of the reservoir populations for *Leptospira* and an environment favorable to its transmission, particularly during periods of heavy rainfall.[6,10–12] Moreover, residence in areas of slum communities that are at risk for flooding, such as at the bottom of valleys, has been found to be associated with the presence of *Leptospira* antibodies among slum dwellers.[11] The significance of environmental risk factors for leptospirosis is clear and, generally, necessitates infrastructure interventions such as the construction of formal and functioning wastewater systems and the provision of garbage collection services.

In addition, socioeconomic characteristics have been identified as independent risk factors for *Leptospira* transmission among residents of an urban slum.[11] This finding suggests that small disparities in socioeconomic status—even those found in a small area among overall impoverished population of slum dwellers sharing the same environmental risk factors—can affect individual behaviors and favor the transmission of leptospirosis. Therefore, understanding individual behavior among residents of communities at high risk for leptospirosis is essential to developing appropriate prevention strategies at the community, household, and individual levels.

Few studies have focused on the knowledge, attitudes, and practices (KAP) related to leptospirosis, its transmission, and prevention.[13–16] Moreover, there is no published KAP studies conducted among residents of an urban slum community focused on leptospirosis. The main objective of this study was to describe the KAP related to leptospirosis among residents of an urban slum community where a cohort study to determine risk factors for leptospirosis infection is ongoing.

MATERIALS AND METHODS

Setting. Salvador, the capital of the state of Bahia, is located in northeastern Brazil and has an estimated population of 2.7 million inhabitants in 2010[17]; the study site, Pau da Lima, is located in the periphery of Salvador. A census survey conducted by the study group in 2003 estimated that 14,122 inhabitants lived in the study site, which has an area of 0.46 km.[2,11] As previously described, the study site is characterized by hills and valleys, poor sanitation infrastructure (i.e., open sewers, refuse, and inadequate floodwater drainage) and an impoverished population.[11] Active, hospital-based surveillance between 2003 and 2007 found that the mean annual incidence of leptospirosis in the study site was 25.1 cases per 100,000 population (Ko A, unpublished data). In 2003, a community-based serological survey found *Leptospira* antibodies in 15.4% of 3,171 eligible residents tested.[11]

Study subjects. Residents of Pau da Lima who were previously identified by the 2003 census were eligible to participate in the present KAP study if they reported sleeping in the study area more than 2 nights per week and were at least 5 years of age at the time of the census. A computer-based random number generator (R software, http://www.r-project.org) created a list of 326 residents from a database of all (N = 14,122) eligible residents. This sample size was calculated to detect a precision of ±6% assuming a 50% positive response frequency and that 20% of the selected individuals

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would not be included in the study because of loss caused by outmigration from the study site. Subjects were enrolled into the study according to written informed consent protocols approved by the Institutional Review Boards of the Oswaldo Cruz Foundation, Brazilian National Commission for Ethics in Research, and Yale School of Public Health, Yale University. Minors < 18 years of age provided written informed assent and their legal guardians provided written informed consent.

Survey instrument. Oral interviews were conducted using a standardized survey instrument, which was adapted following the recommendations for KAP studies.[18] The semi-structured questionnaire consisted of 32 open-ended and 26 closed-ended questions (questionnaire is available by request). Multiple answers per respondent were recorded for the open-ended questions. For the closed-ended questions, interviewers selected the answer choice corresponding to the participants' response from a list of options that were not provided to the participant. The 58 questions in the questionnaire fell into the following categories: demographic and socioeconomic characteristics; knowledge of leptospirosis (symptoms, modes of transmission, and prevention); feelings and beliefs about the disease and its distribution in the community (proxy questions to determine attitudes about leptospirosis); individual and household level practices related to environmental risk factors for leptospirosis (e.g., contact with sewage, rats, and trash). The study team of trained community health workers administered the questionnaire during household visits between May and June 2007.

Data analysis. The study team reviewed completed questionnaires and the data were double entered into an electronic database and validated. Descriptive analyses were performed using (EpiInfo version 3.5.1, Centers for Disease Control and Prevention, Atlanta, GA). The χ^2 was used to compare categorical data and a P value of 0.05 or less was used as criteria for a statistically significant difference.

RESULTS

Demographics. Of the 326 residents selected to participate, 257 (79%) enrolled in the study. Of the 69 people who did not participate, 58 (84%) had moved out of the study site, five people (7%) refused to participate, four people (6%) were deceased, and two people (3%) were not found at home on three separate attempts by the study team. The 257 study participants represent 183 households in the study area. The age range of the study participants was 8–84 years with a median age of 28 (interquartile range: 17–44) years and 104 (40%) were male (Table 1). Of the 257 participants, 216 (84%) self-reported their race as black or mixed (Table 1). Median household per capita income for study subjects living in the 183 households was US$ 3.7 per day; and 163 (89%) of the head of the households did not have legal title to their house. A total of 177 participants (69%) did not complete primary school and 11 (4%) were illiterate (Table 1). The primary occupations were employment outside the home (122; 47%), student (73; 29%), and head of the household (36; 14%) (Table 1).

Knowledge. Of the 257 people interviewed, 232 (90.3%) had previously heard about leptospirosis. When asked "What is leptospirosis?" 197 (76.6%) respondents identified it as a disease and 187 (72.7%) said that leptospirosis is a disease transmitted by rats (Table 2). When asked how leptospirosis is transmitted, 148 (56.4%) respondents independently stated that people get the disease through contact with urine of rats (Table 2). Study participants also reported that leptospirosis can be transmitted when people walk without shoes (42.0%), come into contact with flood water (31.1%), clean an open

TABLE 1

Demographic, socioeconomic, and occupational characteristics of study population (N = 257) in an urban slum community in Salvador, Brazil, August 2007

Characteristic	No. or median*	% or IQR*
Demographics		
Male gender	104	40.4
Age	28	17–44
Socioeconomic indicators		
Incomplete primary school	177	68.8
Black or mixed race	216	84.0
Household per capita income, US$/day	3.7	2.1–5.3
Occupation		
Used	122	47.5
Student	73	28.4
Housewife	36	14.0
Unemployed	15	5.8
Retired	11	4.3

*Numbers and percentages are shown for categorical variables. Median and interquartile range (IQR) are shown for continuous variables of age and per capita household.

TABLE 2

Knowledge about leptospirosis among residents of an urban slum community in Salvador, Brazil

Knowledge regarding leptospirosis*	Number (N = 257)	%
What is leptospirosis?		
It is a disease	197	76.6
It is a disease transmitted by rats	187	72.7
It kills people	11	4.2
Do not know	32	12.5
How is leptospirosis transmitted?		
Contact with urine of rats	148	56.4
Walking without shoes	108	42.0
Contact with flood waters	80	31.1
Cleaning open sewers	50	19.4
Contact with garbage	27	10.5
Do not know	30	11.6
What can be done to avoid leptospirosis?		
Using shoes	195	75.8
Avoiding contact with flooding	74	28.7
Avoiding contact with garbage	42	16.3
Avoiding garbage accumulation	26	10.1
Avoiding scraps foods at home	18	7.0
Using protective equipment/clothing	18	7.0
Do not know	33	12.8
What are the symptoms of leptospirosis?		
Fever	136	52.9
Headache	90	35.0
Myalgia	65	25.2
Jaundice	40	15.5
Malaise	24	9.3
Chills	21	8.1
Weakness	9	3.5
Gastrointestinal pain	5	1.9
Do not know	81	31.5
Does leptospirosis have a cure?		
Yes	208	80.9
No	32	12.5
Do not know	17	6.6
Can leptospirosis kill?		
Yes	230	89.6
No	17	6.6
Do not know	10	3.8

*All questions in this table were open-ended questions and multiple responses recorded for each respondent.

TABLE 3

Sources of leptospirosis knowledge among residents of an urban slum community in Salvador, Brazil

Source of knowledge*	Number ($N = 257$)	%
TV	113	43.9
Friends/neighbors	106	41.2
Health Services	101	39.2
School	77	29.9
Family	32	12.4
Work	19	7.4
Newspapers	11	4.2
Radio	10	3.9
Community association	6	2.3
Do not hear about leptospirosis	24	9.3

*Open-ended question; multiple responses recorded for each respondent.

sewer (19.4%), and come into contact with garbage (10.5%) (Table 2). When asked about the symptoms of leptospirosis, 176 (68.5%) respondents spontaneously reported at least one symptom of the disease. More frequently reported symptoms were fever (53%), headache (35%), and myalgia (25%). Additionally, 230 (89.6%) respondents answered "yes" when asked if leptospirosis can kill (Table 2). Respondents identified the source(s) of their leptospirosis knowledge (e.g., TV, work, community association) (Table 3).

Attitudes. To assess perception related to leptospirosis severity we compared leptospirosis with other diseases that were well recognized in the community. Of the 257 respondents, 183 (71%) reported that they considered leptospirosis more severe than dengue fever. Among 176 respondents, 89 (50%) reported that they felt leptospirosis was the most important disease, which requires prevention and control in their community. Other answers to this question were dengue (26; 15%), acquired immunodeficiency syndrome (AIDS) (19, 10%), and meningitis (16, 9%). Respondents identified the following actions as necessary to control any transmissible disease in their community: closing the sewers (74; 42%); controlling the rat population (34; 21%); improving trash collection (30; 17%). Among 176 respondents, 119 (68%) reported that they would like to perform activities to improve the conditions of the sewers in their community (i.e., close sewers, clean sewers, or do not throw garbage into sewer) and 117 (67%) would pay for a private trash collection service to avoid trash accumulation in their community. The median value respondents would pay for a private trash collection system was 2.9 US$ per week (range 0.6–31.2).

Practices. Among the 257 people interviewed, 45 (17%) reported cleaning an open sewer, a risk activity for leptospirosis, in the past month (Table 4). Among those who cleaned an open sewer in the past month, 16 (35%) reported using gloves and 15 (33%) reported wearing boots to perform that activity (Table 4). Of the 15 people who reported wearing boots when cleaning sewers, 8 (53%) reported that they borrowed the boots from a neighbor because they did not own a pair themselves.

Among those interviewed, 216 (84%) reported seeing rats in or around their home and 252 (98%) reported that they engage in activities to control rats in their home (Table 4). Among the 257 respondents who attempt to control rats in their homes, the methods they used were poison (121; 47%); closing sites that rodents could use to enter their house (116, 45%); filling the rat burrows in or around their house (64; 25%); setting rat traps (62; 24%). From the 151 participants who used poison or traps to control rats, 118 (78%) justified their use to control disease, specifically 33 of them (22%) to control leptospirosis, 28 (18%) performed rat control because rats eat their food, 17 (11%) because rats are disgusting, and 11 (7%) because rodents damaged clothes and furniture. Of the 122 respondents who reported using poison to control rats, 88 (72%) said they used an illegal rodenticide.

TABLE 4

Individual behavior and household level practices related to sewage, rats, and garbage among residents of an urban slum community in Salvador, Brazil

Practice regarding leptospirosis	No. ($N = 257$)	%
Cleaned an open sewer in the last month	45	17.5
Type of protection used	($N = 45$)	
Gloves	15	33.3
Boots	14	31.1
Gloves and boots	5	11.1
Nothing	16	35.5
Activities to prevent rodents at home*		
Use of any poison	122	47.4
Use of illegal poison (*chumbinho*)	88	34.2
Closure of rodent access to house	117	45.5
Closure of rat burrows	66	25.6
Use of rat traps	62	24.1
Nothing	5	1.9
Frequency of garbage elimination	($N = 239$†)	
7 days per week	146	56.6
5–6 days per week	23	8.9
3–4 days per week	16	6.2
1–2 days per week	54	20.9

*Open-ended question; multiple responses recorded for each respondent.
†Data not available for 18 study participants.

Of the 257 people interviewed, 146 (56%) reported removing trash from their household daily; 175 (68%) respondents were able to identify a trash can they used on a regular basis, and 102 (58%) said that the nearest trash can was > 50 m far from their homes. Among 210 respondents, 17 (8%) reported that they currently pay someone outside their household to transport their household garbage to the trash can.

Influence of socio-demographic characteristics in the knowledge and practices. Studied participants ≥ 18 years of age and who had completed primary school more frequently gave correct answers to the questions "What is leptospirosis," "What can be done to avoid leptospirosis?" and "What are the symptoms of leptospirosis?" than studied participants < 18 years of age and who did not complete primary school (Table 5). Participants ≥ 18 years of age also had a higher proportion of correct answers to the question "How is leptospirosis transmitted?" when compared with < 18 years of age participants. Use of illegal poison to control rats was more frequently reported by those < 18 years of age, of male gender, and unemployed. Participants that self-identified as black reported a lower frequency of garbage removal than residents who self-identified as other races. Household per capita income did not have a significant relationship with any of the knowledge and practice variables. Differences were also not observed for the questions "Does leptospirosis have a cure?" and "does leptospirosis kill?" (data not shown).

DISCUSSION

This study identified barriers to translating knowledge and attitudes about leptospirosis into practices that reduce the

TABLE 5

Knowledge and practices regarding leptospirosis compared with socio-demographic variables among residents of an urban slum community in Salvador, Brazil

	Gender		Age (years)		Completed primary school		Race		Unemployed	
Knowledge and practices regarding leptospirosis	Male	Female	< 18	≥ 18	Yes	No	Black	Other	Yes	No
Knowledge	Number (%) of residents that correctly answered questions regarding leptospirosis									
What is leptospirosis	95 (91)	130 (85)	53 (79)*	172 (90)	78 (98)*	143 (83)	188 (87)	37 (90)	14 (93)	211 (87)
Leptospirosis transmission	93 (89)	134 (88)	53 (79)*	174 (92)	75 (94)	152 (86)	191 (88)	36 (88)	13 (87)	214 (88)
Leptospirosis prevention	91 (87)	137 (87)	49 (73)*	175 (92)	75 (94)*	149 (84)	188 (87)	36 (88)	13 (87)	211 (87)
Leptospirosis symptoms	71 (68)	105 (69)	39 (58)*	137 (72)	64 (80)*	112 (63)	148 (68)	28 (68)	11 (73)	165 (68)
Practice	Number (%) of residents that referred the following practices									
Use of gloves/boots to clean sewer	16 (76)	13 (54)	8 (67)	21 (64)	18 (62)	11 (69)	19 (61)	10 (71)	2 (50)	27 (66)
Use of illegal poison (*chumbinho*)	79 (76)*	90 (59)	52 (78)*	117 (62)	54 (67)	115 (65)	142 (66)	27 (66)	14 (93)*	155 (64)
Garbage elimination < 2 day per week	84 (80)	119 (78)	50 (75)	153 (80)	65 (81)	138 (78)	164 (76)*	39 (95)	11 (73)	192 (79)

*Statistical significant difference between the compared groups ($P < 0.05$).

transmission of *Leptospira* among an urban slum population at high risk for exposure to the bacteria. Specifically, the majority of residents surveyed who cleaned open sewers did not use adequate protective clothing and most residents surveyed reported inadequate or unsafe measures to control household rat infestation (i.e., non-daily garbage removal or use of an illegal and hazardous rodenticide). The most frequently reported method for rat control among this population is *chumbinho*, an illegal and dangerous rodenticide known to contain acetylcholinesterase inhibitor insecticides, mainly aldicarb, which is widely available in the community. These practices do not match the knowledge or attitudes of the residents. The majority of residents surveyed reported that leptospirosis was the most important disease to be controlled in their community; furthermore, the majority of residents were able to identify contact with rats as a risk factor for leptospirosis; many understood that contact with open sewers, garbage, and flood waters were risk factors for leptospirosis.

Few reports on KAP related to leptospirosis have been published. The published studies represent heterogenic populations and most focus on knowledge, and include few findings on attitudes and practices. Knowledge regarding leptospirosis and its causes was identified as a protective factor (odds ratio = 0.39; 95% confidence interval between 0.16 and 0.93) against leptospirosis in a study in Jamaica,[19] but no other studies have explored this association. In our study, 90% of the urban slum residents had heard about leptospirosis. This number is comparable to the proportion registered among canoeists and dairy farmers from England where 95% and 90% of study respondents, respectively, reported having heard of leptospirosis.[14,20] Furthermore, the level of knowledge about the transmission of leptospirosis was similar among participants in this study and among canoeists from England; 88% of the respondents in Salvador and 80% in England correctly identified sources of leptospirosis transmission.[14] Our study and the study by Phillip and others found a higher level of knowledge about the symptoms and modes of transmission of leptospirosis than studies conducted among residents of urban and rural areas of Sri Lanka,[15,21] rural villagers in Thailand,[13] and animal shelter workers from the United Sates.[16]

Our study identified two potential reasons why community members are not able to make appropriate behavior changes despite a high level of knowledge about leptospirosis and attitudes that favor risk reduction. First, appropriate personal protective clothing is not readily available and many of the residents who cleaned sewers reported that they borrowed boots or gloves from neighbors. This likely inhibits the use of adequate protective clothing by individuals on a regular basis. Second, trash cans are located far from the homes of most residents and services are not available to help transport garbage despite willingness to pay. If access to personal protective clothing was increased and if support for daily garbage removal was expanded through the addition of trash cans and normalization of informal employment of people to remove waste, residents are likely to adopt these methods of risk reduction. Our study therefore identified numerous barriers at the community level that inhibit individual practices that would favor a reduction of *Leptospira* transmission.

This study has limitations that may affect the generalizability of the results to other communities and populations. First, study participants were part of a large, prospective cohort study initiated in 2003 aimed to identify risk factors for leptospirosis and so the knowledge, attitudes, and practices reported here may have been influenced by previous interviews. The second limitation of this study is that we were not able to include 21% of the individuals randomly selected to participate in the study. However, we believe that the included group should fairly represent the selected sample of residents of Pau da Lima as the most common reason to loss was outmigration, and univariate comparisons of age and sex distribution between individuals included and not included in the study showed no significant differences between the groups. Furthermore, 81 of 257 participants were not asked a series of questions about attitudes regarding leptospirosis because of an error in data collection. The level of knowledge and the practices reported by these 81 study participants were not different than what was found among those who responded to all questions and there was not a difference in major demographic factors between the two groups. Therefore, we do not believe that the lack of data for these 81 respondents biases our results about attitudes toward leptospirosis.

Large-scale infrastructure projects such as the construction of formal and functioning wastewater systems and the provision of formal garbage collection services have the potential to reduce the incidence of leptospirosis in urban slum communities. Until these infrastructure interventions can be undertaken, community and individual level interventions must be supported and enhanced to reduce the burden of infectious diseases in urban slum communities. Although our study was not designed to evaluate the association between leptospirosis knowledge and risk of infection, education and public awareness campaigns alone are unlikely to be effective in achieving

these goals given the high level of knowledge about leptospirosis and prevailing attitudes toward possible sources of infection. The results of this study suggest that members of urban slum communities will take measures to reduce their exposure to sources of *Leptospira* and reduce household rat infestation if the community supports their efforts through the availability of appropriate goods and services.

Received April 16, 2012. Accepted for publication September 28, 2012.

Published online December 26, 2012.

Acknowledgments: We thank Ana Claudia da Silva Batista for database management. We also thank community leaders of Pau da Lima for their support during data collection.

Financial support: This work was supported by the Secretariat of Health Surveillance, the Oswaldo Cruz Foundation, and the National Institutes of Health (grants U01 AI088752, R01 AI052473, R25 TW009338 and D43 TW00919, Office of the Director, Fogarty International Center, Office of AIDS Research, National Cancer Center, National Eye Institute, National Heart, Blood, and Lung Institute, National Institute of Dental and Craniofacial Research, National Institute On Drug Abuse, National Institute of Mental Health, National Institute of Allergy and Infectious Diseases, and National Institutes of Health Office of Women's Health and Research through the Fogarty International Clinical Research Scholars and Fellows Program at Vanderbilt University [R24 TW007988], and the American Relief and Recovery Act).

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