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Zika Virus: Knowledge Assessment of Residents and Health-Care Providers in Roatán, Honduras, following an Outbreak

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Abstract. Few studies have evaluated the effectiveness of Zika virus (ZIKV) public health educational campaigns. Following a ZIKV educational campaign in Roatán, Honduras (October 2016), a survey was administered (March–May 2017) to residents ($N = 348$) and health-care professionals ([HCPs]; $N = 44$) to evaluate ZIKV knowledge, attitudes, and preventive practices, with attention to sexual health. Knowledge scores were calculated and mapped using participants' home locations. The knowledge scores between HCPs and residents were significantly different (mean 17 versus 11; $P < 0.001$). Only 6% of residents and 14% of HCPs knew that ZIKV was sexually transmissible. Few reported abstinence (2.6% residents; 9.4% HCPs) or condom use (1.6% residents; 12.5% HCPs) to prevent ZIKV infection. Of all subjects, 15.6% were pregnant or had a pregnant partner in the past year; 57.6% expressed concern over ZIKV. Mapping demonstrated spatial heterogeneity in knowledge. The findings suggest a need for improved public health messaging in ZIKV-affected areas.

INTRODUCTION

Zika virus (ZIKV) is a mosquito-borne flavivirus that gained global attention for its rapid epidemic spread through the Americas in 2015–2016 and severe teratogenic effects, including microcephaly and fetal loss, when contracted during pregnancy.[1] To date, more than 80 countries or territories have reported cases of ZIKV infection.[2] Although mosquito-borne transmission is overwhelmingly predominant, sexual transmission (male to female, female to male, and male to male) is well described.[3–7] At the time of writing, 13 countries have reported sexual transmission of ZIKV; 49 cases of sexually transmitted ZIKV have been reported in the United States.[8,9] Zika virus is capable of persisting in the genital tract even after the virus has been cleared from blood and urine.[10] Consequently, Centers for Disease and Control and Prevention recommends either sexual abstinence or barrier contraceptive methods (e.g., condom use) for extended periods of time following potential exposure to ZIKV to prevent sexually transmitted infection.[11]

Despite public health educational campaigns that were launched following the emergence of ZIKV,[12] few studies have evaluated the outcomes with respect to knowledge of ZIKV and concomitant practices to prevent ZIKV.[13–15] In October 2016, the local health authorities in Roatán, Honduras, initiated a public health educational campaign, following the local emergence of ZIKV[16]; ZIKV informational posters were positioned at local airports and hospitals. The educational campaign coincided with an increase in mosquito control efforts. In 2017, approximately 6 months following initiation of the public health campaign, we sought to assess the knowledge of ZIKV and associated preventive practices among the residents and their health-care providers (HCPs) in Roatán. In addition to general knowledge of ZIKV, the survey sought to evaluate awareness of ZIKV's risk to pregnancy and sexual health specifically. Insight into educational outcomes can be used to aid local governments to develop or refine policies and interventions.[17] In this case, interventions relate to achievement of ZIKV control.

THE STUDY

A paper-based survey was administered to residents ($N = 348$) and HCPs ($N = 44$) at the Roatán Public Hospital and four clinics (public and private) in Roatán (March–May 2017). Roatán is the largest of the Bay Islands. Roatán Public Hospital is the only public hospital in Roatán, thus offering broad representation by geography and demographic on the island. The survey was adapted from the "Knowledge, Attitudes and Practice surveys: Zika virus disease and potential complications Resource Pack" that was developed by the World Health Organization (WHO) to evaluate local prevention and control measures related to ZIKV mitigation.[18] The WHO survey was modified with minor amendments to the wording and length of the original questionnaire. The survey was piloted with 16 residents and four HCPs, representing each of the study sites. The survey was conducted in the participant's preferred language—either English or Spanish–using both open- and closed-ended questioning. Trained Honduran and United States medical students administered the survey. The survey included 37 questions pertaining to 1) demographic characteristics; 2) knowledge of ZIKV clinical presentation, modes of transmission, and related preventive measures; 3) attitudes of participants to ZIKV risk, contraception use, and abortion (including perception of stigma); and 4) practices to prevent mosquito-borne and sexual transmission of ZIKV. The complete list of questions is available in the Supplemental Material.

On conclusion of the study enrollment, participants' addresses were mapped using a hand-held eTrex 20 (Garmin, Lenexa, KS); the latter generated global positioning system coordinates for the participants' homes. The survey, laboratory test data, and global positioning system coordinates were uploaded into ArcGIS version 10.3.1 software (Esri, Inc., Redlands, CA). The participants' knowledge scores were

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mapped using the corresponding study participants' home locations. The survey data were tabulated for all questions and summarized using counts and percentages. The total score, representing ZIKV knowledge, was calculated by adding one point for each correct response to Questions 5–12 and Questions 16–18 (Supplemental Material). For the bivariate analyses, the χ^2 test was used to compare categorical variables; analysis of variance was used to compare scores over groups within covariates. All statistical analyses were conducted using Stata 15.0 (StataCorp, College Station, TX).

A total of 375 residents and 50 HCPs were approached, of whom 92.8% (N = 348) of residents and 88.0% (N = 44) of HCPs were enrolled successfully (Table 1). The median age of participants was 31 (range 18–31) years, 75.8% (N = 297) were female, 39.3% (N = 154) had less than a high school education, 41.3% (N = 162) were high school graduates, and 19.4% (N = 76) were college graduates.

There was a statistically significant difference in the total knowledge score between HCPs and residents (mean 17 versus 11, respectively; $P < 0.001$, standard deviation: 5.1). The majority of residents (86.3%, N = 300) and HCPs (79.5%, N = 35) knew that ZIKV was transmitted via mosquitos (Table 2); 60.6% (N = 211) of residents and 77.3% (N = 34) of HCPs stated that ZIKV transmission was occurring in Roatán. Just over half (54.5%, N = 24) of HCPs reported that ZIKV posed a serious health concern to the community versus 68.4% (N = 238) of residents. Less than half of residents (43.1%, N = 150) reported being informed by their HCPs regarding individual actions that could be taken to prevent ZIKV infection. When asked, "What actions have you taken to protect yourself from getting infected with ZIKV?" the most frequently reported actions among participants included elimination of standing water (34.4%, N = 11 residents versus 68.2%, N = 30 HCPs), wearing protective clothing (25%, N = 8 residents versus 39.8%, N = 76 HCPs), and the use of a mosquito net (12%, N = 23 residents and 40.6%, N = 13 HCPs).

Only 6% (N = 19) of residents and 14% (N = 6) of HCPs knew that ZIKV could be transmitted sexually. Few participants abstained from sex to prevent ZIKV infection (2.6%, N = 5 residents and 9.4%, N = 3 HCPs). Furthermore, although condoms were reportedly available, their use to prevent ZIKV infection was low (1.6%, N = 3 residents and 12.5%, N = 4 HCPs). Despite that the vast majority of participants (91.1%, N = 317 and 86.4%, N = 38 of residents and HCPs, respectively) reported that they trusted HCPs to provide the most accurate information regarding ZIKV, only 4% (N = 7) of respondents reported that their HCP had discussed sexual abstinence and 7.9% (N = 14) had discussed condom use as a way to prevent ZIKV infection with them.

Only 56.9% (N = 198) of residents and 75.0% (N = 33) of HCPs reported that women should avoid becoming pregnant if at risk of ZIKV exposure; at the time of the survey, 15.6% (N = 61) of all subjects were pregnant or reported having had a partner who was pregnant in the past year. Among residents who were either pregnant or had a partner who was pregnant within the last year, 57.6% (N = 34) reported concern about becoming infected with ZIKV. Residents and HCPs were asked whether they would support abortion in reference to ZIKV-associated fetal abnormalities. In this setting, the majority (65.2%, N = 278 residents and 76.5%, N = 36 HCPs) disapproved of abortion. Mapping of the total Zika knowledge scores suggested that knowledge was spatially heterogeneous on the island (Figure 1). The total knowledge scores among the respondents varied by location, from a low of 6.75 in Crawfish Rock to a high of 14.29 in West End. There were statistically significant differences in the knowledge scores among respondents

TABLE 1

Demographic characteristics of residents and health-care provider (HCP) respondents, March–May 2017

Characteristic	No. (%)	
	Residents (N = 348)	HCPs (N = 44)
Gender		
Male	82 (23.6)	13 (29.5)
Female	266 (76.4)	31 (70.5)
Age group (years)		
18–24	86 (24.7)	7 (15.9)
25–34	118 (33.9)	28 (63.6)
35–44	52 (14.9)	6 (13.6)
45–54	48 (13.8)	3 (6.8)
55–64	30 (8.6)	0 (–)
≥ 65	14 (4.0)	0 (–)
Highest level of education		
None	19 (5.5)	0 (–)
Preschool through grade 6	133 (38.2)	2 (4.5)
High school diploma	158 (45.4)	4 (9.1)
College graduate	38 (10.9)	38 (86.4)
Race/ethnicity		
Mestizo	220 (63.2)	27 (61.4)
Negro ingles	81 (23.3)	8 (18.2)
Garifuna	33 (9.5)	4 (9.1)
Other	14 (4.0)	5 (11.4)
Religion		
Roman Catholic	73 (20.9)	15 (34.1)
Adventist	44 (12.6)	2 (4.5)
Other Christian	62 (17.8)	10 (22.7)
Evangelical Protestant	129 (37.1)	13 (29.5)
Other religion	40 (11.5)	4 (9.1)
Employment		
Housewife/domestic services	189 (54.3)	0 (–)
Sales and services/tourism	85 (24.4)	0 (–)
Professional	37 (10.6)	1 (2.3)
Fishing/farming	20 (5.7)	0 (–)
Doctor*	3 (0.9)	20 (45.5)
Nurse/laboratory technician*	14 (4.0)	23 (52.2)
Location of household		
Coxen Hole	67 (19.3)	13 (29.5)
Los Fuertes	56 (16.1)	7 (15.9)
French Harbor	45 (12.9)	1 (2.3)
Oak Ridge	19 (5.5)	5 (11.4)
Punta Gorda	23 (6.6)	2 (4.5)
Sandy Bay	37 (10.6)	3 (6.8)
Flowers Bay	22 (6.3)	0 (–)
West End	7 (2)	0 (–)
Crawfish Rock	4 (1.1)	0 (–)
Other	68 (19.5)	13(29.5)
Frequency of visits to a HCP		
More than monthly	241 (69.3)	19 (43.2)
Monthly	39 (11.2)	11 (25.0)
1–2 per year	36 (10.3)	11 (25.0)
Never	32 (9.2)	3 (6.8)
Number of women in the household of childbearing child age		
None	18 (5.2)	4 (9.1)
1	160 (45.9)	24 (54.5)
2	95 (27.3)	9 (20.5)
3	46 (13.2)	5 (11.4)
4+	29 (8.3)	2 (4.4)

* For purposes of study, HCP was defined as used in one of the defined professions (i.e., doctor, nurse, or laboratory technician) for the past 6 months or more.

TABLE 2
Awareness, risk perceptions, and actions taken among residents and health-care providers (HCPs)—Roatán, Honduras, March–May 2017

	No. (%)	
Awareness of Zika	Residents (*N* = 348)	HCPs (*N* = 44)
Learned of Zika > 1 year ago	273 (78.4)*	41 (93.2)*
Learned of Zika < 1 month ago	4 (1.1)*	1 (2.3)*
Other†	71 (20.4)**	2 (4.5)**
Symptoms of Zika		
Fever	232 (66.7)**	34 (77.3)**
Rash	91 (26.1)	27 (61.4)
Headache	168 (48.2)*	29 (65.9)*
Joint pain	170 (48.9)*	29 (65.9)*
Conjunctivitis	52 (14.9)**	24 (54.5)**
Can be asymptomatic	118 (33.9)	11 (25.0)
Transmission		
Zika is a virus	39 (11.2)**	22 (50.0)**
Mosquito-borne	300 (86.2)	35 (79.5)
Sexually transmissible	19 (5.5)*	6 (13.6)*
Beliefs regarding risk		
ZIKV is a serious health concern	238(68.4)	24(54.5)
ZIKV infection possible in Roatán	211 (60.6)	34 (77.3)
Everyone is at risk of ZIKV infection	328 (94.3)	44 (100)
Knows someone diagnosed in past 6 months	55 (15.8)	8 (18.2)
Protective actions		
Zika is preventable	297 (85.3)*	43 (97.7)*
Zika treatment is available	214 (61.7)	32 (72.7)
Zika vaccine is available‡	83 (38.8)**	1 (3.1)**
Personal protective behaviors		
Has tried to prevent ZIKV infection§	*N* = 191 (54.9)*	*N* = 32 (72.7)*
Mosquito net	23 (12.0)**	13 (40.6)**
Clothing covering arms and legs	8 (25.0)	76 (39.8)
Condom use	3 (1.6)**	4 (12.5)**
Sexual abstinence	5 (2.6)	3 (9.4)
Elimination of standing water	11 (34.4)*	30 (68.2)*
Interaction with HCP		
Most correct ZIKV information is from HCP	317 (91.1)	38 (86.4)
Discussed Zika with HCP‖	*N* = 150 (43.1)*	*N* = 27 (61.4)*
HCP recommended mosquito net use	112 (74.7)	23 (85.2)
HCP recommended the use of protective clothing	40 (26.7)**	18 (66.7)**
HCP recommended condom use	12 (8.0)**	12 (44.4)**
HCP recommended abstinence	3 (2.0)**	4 (14.8)**
HCP recommended standing water removal	59 (39.3)**	20 (74.1)
Desire more ZIKV information	196 (97.5)	31 (91.2)
Beliefs regarding family planning		
Women should avoid pregnancy at this time	198 (56.9)*	33 (75.0)*
Abortion should be allowed given ZIKV risk	70 (34.8)	8 (23.5)
Pregnant partners in the past year¶	*N* = 59 (17.0)	*N* = 2 (4.5)
Concerned ZIKV in utero infection	34 (57.6)	2 (100)
Considered delaying pregnancy	11 (18.6)	0 (–)
If yes, had access to contraception	11 (100)	

ZIKV = Zika virus.
* Statistical significance of < 0.05, ** Statistical significance < 0.01 as compared with residents versus HCPs.
† Additional responses included: 6 months–1 year, 1–5 months.
‡ Proportion for residents and HCPs is from a sample of 214 and 32 residents and HCPs, respectively.
§ Proportion for residents and HCPs for this section is from a sample of 191 and 32 residents and HCPs, respectively.
‖ Proportion for residents and HCPs for this section is from a sample of 150 and 27 residents and HCPs, respectively.
¶ Proportion for residents and HCPs for this section is from a sample of 59 and two residents and HCPs, respectively.

between the locations with the lowest total scores (i.e., Crawfish Rock, Flowers Bay, and Punta Gorda) and those with the highest scores (i.e., Los Fuertes, Oak Ridge, and West End) after adjusting for multiple comparisons ($P < 0.06$; Supplemental Table 1). Census data are needed to improve the correlation of knowledge scores with income or level of education.[19]

The study has limitations. First, a convenience sample of survey venues was used. Second, the research personnel administered the surveys (rather than have the participants complete on their own); therefore, the responses were subject to social desirability bias. Furthermore, despite the high rates of participation, one is unable to assess ZIKV knowledge in nonresponders, that is, selection bias needs to be acknowledged. Nonetheless, the study provides insight into the awareness, beliefs, and actions of Roatán residents and HCPs, which could enable public health officials to improve messaging and bolster the ZIKV response effort.

CONCLUSION

Despite a public health education campaign in Roatán, the limited knowledge of ZIKV sexual transmission may impede local eradication efforts that are focused, primarily, on mosquito control. Since 2015, the WHO has issued recommendations aimed to decrease ZIKV infection.[20] The WHO states that the

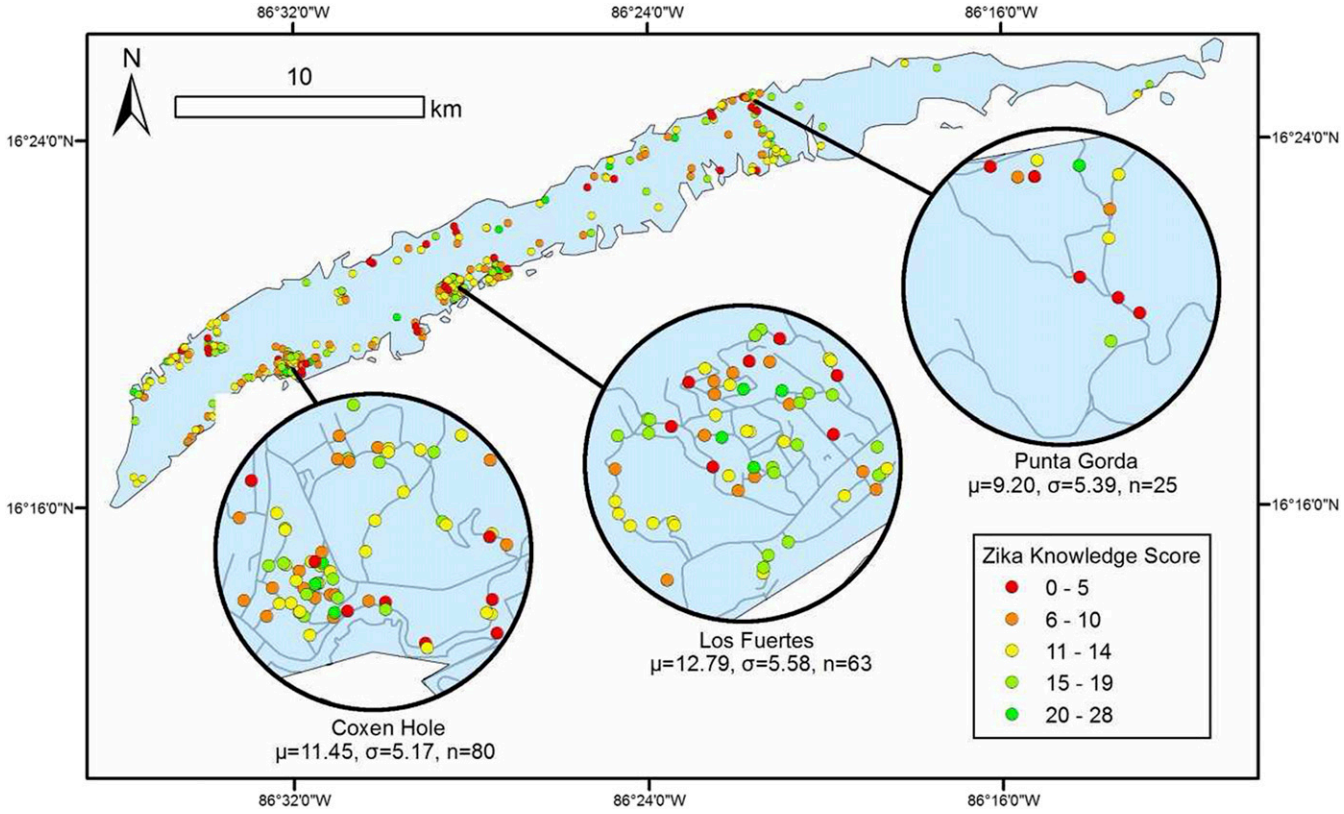

FIGURE 1. Spatial distribution of Zika Knowledge Scores among residents and health-care providers in Roatán, Honduras, March 2017–May 2017. The regions displayed in the insets are those for which we obtained the most samples. Island-wide Zika knowledge score appears to be normally distributed with the sample mean (11.78), median (12), and standard deviation (5.11). This figure appears in color at www.ajtmh.org.

guidance is "intended to inform the general public and to be used by health-care workers and policy makers." Our study suggests that both residents and HCPs in ZIKV-endemic regions, such as Roatán, may not be adequately informed of their risks of exposure and the available resources to prevent ZIKV infection and its associated complications. Similarly, studies conducted in the continental United States (United States and United States Virgin Islands) indicated the need to improve messaging in regard to modes of transmission, whereby most of the participants did not know that ZIKV could be spread through sex.[14,15] Refinement and possible expansion of educational initiatives are needed to control ongoing ZIKV transmission and/or improve preparedness during future outbreaks.

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Note: Supplemental information and table appear at www.ajtmh.org.

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