Perceptions of Zika Virus Risk during 2016 Outbreak, Miami-Dade County, Florida, USA

Imelda K. Moise, Joseph Kangmennaang, Tricia Caroline S.G. Hutchings, Ira M. Sheskin, Douglas O. Fuller

Author affiliations: University of Miami, Coral Gables, Florida, USA
(I.K. Moise, T.C.S.G. Hutchings, I.M. Sheskin, D.O. Fuller); University of Waterloo, Waterloo, Ontario, Canada (J. Kangmennaang)

DOI: https://doi.org/10.3201/eid2407.171650

We conducted a survey on Zika virus perceptions and behaviors during the 2016 outbreak in Miami-Dade County, Florida, USA. Among women, Zika knowledge was associated with having a bachelor’s degree. Among men, knowledge was associated with knowing someone at risk. Interventions during future outbreaks could be targeted by sex and education level.

Misconceptions about arboviruses transmitted by Aedes spp. mosquitoes, such as Zika virus, can lead to misplaced reactions and affect local public health officials’ abilities to contain outbreaks (1–3). Despite media campaigns on Zika virus, misperceptions persisted during the 2016 outbreak among some subgroups in Miami, Florida, USA (4). More than 4 in 10 Americans mistakenly thought that Zika virus infection was fatal and that symptoms were noticeable (5).

We conducted a structured bilingual (English, Spanish) telephone survey with a random sample of adults in late spring (May 1–June 30, 2016), when the Zika virus outbreak began in Florida. We applied the basic concepts of the Health Belief Model (HBM) in an attempt to understand perceptions of Zika virus risk and prevention practices in Miami-Dade County, Florida, the epicenter of the 2016 Zika virus outbreak (6).

The HBM provided the framework enabling effective structuring of messages to influence behavioral change in the context of health communication strategies for Zika virus prevention and control. According to the HBM, persons are influenced by their perceived susceptibility to a disease and the severity of that disease (7). To use the HBM, participants must have the ability to implement a desired behavior, self-efficacy (i.e., confidence in their ability to implement that action), and cues to action (which could lead to health behavior changes) (7). Because Zika virus infection mainly affects pregnant

References
1. Woo PC, Wu AK, Tsang CC, Leung KW, Ngan AH, Curreem SO, et al. Streptobacillus hongkongensis sp. nov., isolated from patients with quinqu and septic arthritis, and emended descriptions of the genus Streptobacillus and Streptobacillus moniliformis. Int J Syst Evol Microbiol. 2014;64:3034–9. http://dx.doi.org/10.1099/ijsem.0.061242-0
2. Eisenberg T, Glaeser SP, Ewers C, Semmler T, Nicklas W, Rau J, et al. Streptobacillus notomitys sp. nov., isolated from a spinifex hopping mouse (Notomys alexis Thomas, 1922), and emended description of Streptobacillus Levaditi et al. 1925, Eisenberg et al. 2015 emend. Int J Syst Evol Microbiol. 2015;65:4823–9. http://dx.doi.org/10.1099/ijsem.0.006654
3. Eisenberg T, Glaeser SP, Nicklas W, Mauder N, Contzen M, Aledelbi K, et al. Streptobacillus felis sp. nov., isolated from a cat with pneumonia, and emended descriptions of the genus Streptobacillus and of Streptobacillus moniliformis. Int J Syst Evol Microbiol. 2015;65:2172–8. http://dx.doi.org/10.1099/ijsem.0.000238
4. Eisenberg T, Imaoka K, Kimura M, Glaeser SP, Ewers C, Semmler T, et al. Streptobacillus ratti sp. nov., isolated from a black rat (Rattus rattus). Int J Syst Evol Microbiol. 2016;66:1620–6. http://dx.doi.org/10.1099/ijsem.0.000869
5. Eisenberg T, Ewers C, Rau J, Akimkin V, Nicklas W. Approved and novel strategies in diagnostics of rat bite fever and other Streptobacillus infections in humans and animals. Virulence. 2016;7:630–48. http://dx.doi.org/10.1080/21505594.2016.1177694
6. Eisenberg T, Nicklas W, Mauder N, Rau J, Contzen M, Semmler T, et al. Phenotypic and genotypic characteristics of members of the genus Streptobacillus. PLoS One. 2015;10:e0134312. http://dx.doi.org/10.1371/journal.pone.0134312
7. Elliott SP. Rat bite fever and Streptobacillus moniliformis. Clin Microbiol Rev. 2007;20:13–22. http://dx.doi.org/10.1128/CMR.00016-06
8. Fukushima K, Yanagisawa N, Imaoka K, Kimura M, Imamura A. Rat-bite fever due to Streptobacillus notomitis isolated from a human specimen. J Infect Chemother 2018;24:302–304. Epub 2017 Nov 27.

Address for correspondence: Kei Kasahara, Center for Infectious Diseases, Nara Medical University, Shijo-cho 840, Kashihara, Nara, Japan; email: kassan@naramed-u.ac.jp

Manage your email alerts so you only receive content of interest to you.

Sign up for an online subscription: wwwnc.cdc.gov/eid/subscribe.htm

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 24, No. 7, July 2018 1379
women (8, 9), we report differences in perception and behavior by sex. Our target sample size was 421, with a power of 0.90 and margin of error of 0.4. The survey took 10–30 minutes to complete, and ≈62% (262/421) of the target population participated.

We determined predictive factors of Zika virus knowledge (dependent variable, values 0 or 1) by using multivariate logistic regression with a log-link function adjusted for demographics (age, sex, employment status, education level, income level) and all other variables of the HBM. We presented data as adjusted odds ratios (aORs) with 95% CIs. A low score (0–7 points) on the Zika virus knowledge test indicates the participant correctly answered 0–7 questions and suggests the respondent had simply heard of Zika and knew that mosquitoes could transmit Zika virus. A high score (8–12 points) indicates the participant correctly answered 8–12 questions and suggests the respondent had a good understanding of microcephaly and Guillain-Barré syndrome.

### Table. Multivariate logistic regression analysis of variables associated with high Zika virus knowledge among Miami-Dade County residents, by sex, Florida, USA, 2016*

| Category                                      | Total, n = 262 | Female, n = 149 | Male, n = 113 |
|-----------------------------------------------|----------------|-----------------|---------------|
| Constant†                                     | 0.07 (0.01–0.37)‡ | 0.05 (0.004–0.647)§ | 0.066 (0.004–1.094)¶ |
| Self-efficacy                                 |                |                 |               |
| Confidence to protect household from Zika virus infection |                |                 |               |
| Medium                                        | 1.29 (0.59–2.77) | 1.36 (0.45–4.12) | 1.97 (0.50–7.68) |
| High                                          | 1.26 (0.52–3.05) | 1.15 (0.32–4.13) | 2.81 (0.59–13.14) |
| Took action to protect against Zika virus     |                |                 |               |
| No                                            | Referent       | Referent        | Referent      |
| Yes                                           | 2.39 (1.24–4.61)‡ | 2.30 (0.882–5.999)¶ | 3.18 (1.07–9.44)§ |
| Severity of disease                           |                |                 |               |
| Severity of Zika virus infection              |                |                 |               |
| Less severe                                   | Referent       | Referent        | Referent      |
| Somewhat severe                               | 1.09 (0.38–3.16) | 1.24 (0.27–5.67) | 0.84 (0.13–5.38) |
| Very severe                                   | 1.35 (0.46–3.96) | 2.62 (0.61–11.08) | 0.53 (0.061–4.54) |
| Severity of microcephaly                      |                |                 |               |
| Not severe                                    | Referent       | Referent        | Referent      |
| Somewhat severe                               | 1.07 (0.51–2.27) | 1.26 (0.45–3.58) | 1.04 (0.31–3.51) |
| Very severe                                   | 0.79 (0.34–1.87) | 1.07 (0.32–3.58) | 0.52 (0.12–2.12) |
| Susceptibility to disease                     |                |                 |               |
| How likely are you to contract Zika virus     |                |                 |               |
| Very unlikely                                 | Referent       | Referent        | Referent      |
| Somewhat unlikely                             | 1.56 (0.82–2.96) | 1.34 (0.557–3.226) | 2.45 (0.83–7.26) |
| Likely                                        | 2.36 (0.886–6.25)¶ | 1.36 (0.329–5.795) ¶ | 3.21 (0.70–14.63) ¶ |
| Benefits of action                            |                |                 |               |
| Taking action against Zika virus              |                |                 |               |
| Beneficial                                    | Referent       | NA              | NA            |
| Not beneficial                                | –0.91 (–2.55 to 0.73) | NA              | NA            |
| Possible cues to action                       |                |                 |               |
| Knowing someone at risk for Zika disease (pregnant or planning on being pregnant) |                |                 |               |
| No                                            | Referent       | Referent        | Referent      |
| Yes                                           | 2.13 (0.95–4.77)¶ | 1.15 (0.41–3.22) | 11.73 (2.28–60.28)‡ |
| Demographics                                  |                |                 |               |
| Age                                           | 0.99 (0.97–1.01) | 0.99 (0.96–1.02) | 1.00 (0.97–1.04) |
| Sex                                           |                |                 |               |
| M                                             | Referent       | NA              | NA            |
| F                                             | 1.18 (0.63–2.20) | NA              | NA            |
| Employment status                             |                |                 |               |
| Not in the workforce                          | Referent       | Referent        | Referent      |
| In the workforce                              | 1.23 (0.579–2.605) | 1.02 (0.35–2.97) | 1.15 (0.33–4.02) |
| Education level                               |                |                 |               |
| Less than bachelor’s degree                   | Referent       | Referent        | Referent      |
| Bachelor’s degree or higher                   | 2.37 (1.25–4.47)‡ | 2.92 (1.199–7.12)§ | 1.54 (0.53–4.42) |
| Income level                                  |                |                 |               |
| <$50,000–$100,000                             | Referent       | Referent        | Referent      |
| >$100,000                                     | 0.98 (0.46–2.09) | 1.15 (0.44–2.98) | 0.65 (0.18–2.25) |
| Don’t know or NA                             | 2.06 (0.88–4.78)¶ | 2.51 (0.72–8.73) | 1.75 (0.42–7.32) |
| NA                                            | 0.86 (0.33–2.21) | 1.73 (0.52–5.78) | 0.04 (0.006–0.304)¶ |

*OR, adjusted odds ratios; NA, not applicable.
†The constant is the expected mean value of y when x equals zero.
‡P<0.01.
§P<0.05.
¶P<0.10.
Of the 262 survey participants, 149 (56.9%) were women and 113 (43.1%) were men; age range was 18–94 (mean 49, SD 19) years. More than half (56.9%) of participants were foreign born, 185 (70.6%) considered themselves Hispanic or Latino, and 138 (52.7%) were married. More women (36.9%) than men (31.0%) scored high (8–12 points) for Zika virus knowledge (online Technical Appendix Table, https://wwwnc.cdc.gov/EID/article/24/7/17-1650-Techapp1.pdf).

A total of 53.0% of women and 49.6% of men felt somewhat confident they could protect their households from contracting Zika (online Technical Appendix Table). Personal protective measures included window and door screens, checking for and draining standing water, and using repellents. A higher percentage of women (53.7%) than men (42.5%) perceived Zika to be a severe disease, and women (50.4%) were more likely than men (43.6%) to report fear of contracting Zika.

Taking action to protect oneself against Zika virus infection (aOR 2.39, p = 0.01) and knowing someone pregnant (cue to action) (aOR 2.13, p = 0.10) were associated with a higher knowledge of Zika virus (Table). This high level of knowledge might be attributable to the Florida Department of Health’s aggressive information campaign and a Zika virus information hotline created to help inform the public about Zika virus and procedures to avoid infection. Participants with bachelor’s degrees (aOR 2.37, p = 0.01) were also more likely to be knowledgeable about Zika virus than those without bachelor’s degrees.

Among women, Zika virus knowledge was higher among those who had taken action to prevent Zika virus infection (aOR 2.30, p = 0.10) and those with bachelor’s degrees (aOR 2.92, p = 0.05). However, among men, Zika virus knowledge was higher among those who knew someone at risk for Zika (aOR 11.73, p = 0.01) and those who took action to prevent Zika virus infection (aOR 3.18, p = 0.05).

Our analysis indicates that women were more concerned about Zika than were men in Miami-Dade County and that those with bachelor’s degrees were more knowledgeable than were those without. Therefore, targeting prevention and treatment interventions by sex and education level should be considered to maximize positive outcomes in high-risk areas during outbreaks (10). For local governments, planning and implementing effective interventions aimed at preventing and controlling mosquito-borne disease outbreaks require ongoing assessments of knowledge, attitudes, and practices that are sensitive to local residents’ health practices and concerns. These findings have critical implications for future studies that seek more accurate and confirmatory evidence on the association between socio-demographics and Zika virus–related health practices.

Acknowledgments
We thank all the Miami-Dade County residents who participated in the study and the research assistants who helped interview them: Anairen Rodriguez, Elizabeth Roy, Gabrielle Hesslau, Jacobo Saldarriaga, Julia Hoch, and Nashira Montero. This publication was supported by Cooperative Agreement no. U01CK000510 funded by the Centers for Disease Control and Prevention.

About the Author
Dr. Moise is assistant professor at the University of Miami in Coral Gables, Florida, USA. Her research interests include modeling health behaviors, spatial analysis, and evidence-informed interventions that are culturally responsive to a specific problem identified for a given context and public health practice.

References
1. Rübsamen N, Castell S, Horn J, Karch A, Ott JJ, Raupach-Rosin H, et al. Ebola risk perception in Germany, 2014. Emerg Infect Dis. 2015;21:1012–8. http://dx.doi.org/10.3201/eid2106.150013
2. Poletti P, Ajelli M, Merler S. The effect of risk perception on the 2009 H1N1 pandemic influenza dynamics. PLoS One. 2011;6:e16460. http://dx.doi.org/10.1371/journal.pone.0016460
3. Poletti P, Ajelli M, Merler S. Risk perception and effectiveness of uncoordinated behavioral responses in an emerging epidemic. Math Biosci. 2012;238:80–9. http://dx.doi.org/10.1016/j.mbs.2012.04.003
4. Moore KJ, Qualls W, Brennan V, Yang X, Caban-Martinez AJ. Mosquito control practices and Zika knowledge among outdoor construction workers in Miami-Dade County, Florida. J Occup Environ Med. 2017;59:e17–9. http://dx.doi.org/10.1097/JOM.0000000000000960
5. Annenberg Public Policy Center. More than 4 in 10 mistakenly think Zika is fatal, symptoms are noticeable. 2016 Mar 10 [cited 2017 Oct 4]. https://www.annenbergpublicpolicycenter.org/more-than-4-in-10-mistakenly-think-zika-is-fatal-and-symptoms-are-noticeable/
6. Ajelli M, Moise IK, Hutchings TCGS, Brown SC, Kumar N, Johnson NF, et al. Host outdoor exposure variability affects the transmission and spread of Zika virus: insights for epidemic control. PLoS Negl Trop Dis. 2017;11:e0005851. http://dx.doi.org/10.1371/journal.pntd.0005851
7. Wong LP, AibaBakar S, Chimna K. Community knowledge, health beliefs, practices and experiences related to dengue fever and its association with IgG seropositivity. PLoS Negl Trop Dis. 2014;8:e2789. http://dx.doi.org/10.1371/journal.pntd.0002789
8. Esposito DLA, de Moraes JB, Antônio Lopes da Fonseca B. Current priorities in the Zika response. Immunology. 2018;153:435–42. http://dx.doi.org/10.1111/imn.12878
9. Byron K, Howard D. ‘Hey everybody, don’t get pregnant’: Zika, WHO and an ethical framework for advising. J Med Ethics. 2017;43:334–8. http://dx.doi.org/10.1136/jmedethics-2016-103862
10. Moise IK, Ruiz MO. Hospitalizations for substance abuse disorders before and after Hurricane Katrina: spatial clustering and areal-level predictors, New Orleans, 2004 and 2008. Prev Chronic Dis. 2016;13:160107. http://dx.doi.org/10.5888/pcd13.160107

Address for correspondence: Imelda K. Moise, University of Miami, Geography and Regional Studies, Public Health Sciences, 1300 Campo Sano Ave, Coral Gables, FL 33146, USA; email: moise@miami.edu
Perceptions of Zika Virus Risk during 2016 Outbreak, Miami-Dade County, Florida, USA

Technical Appendix

**Technical Appendix Table.** Characteristics of Miami-Dade County residents, by sex, Florida, USA, 2016*

| Variable                              | Male, n = 113, % | Female, n = 149, % | Pearson χ² | p value |
|---------------------------------------|-----------------|--------------------|------------|---------|
| Zika virus knowledge, dependent variable |                 |                    | 1.01       | 0.32    |
| Low, 0–7                              | 69.03           | 63.09              |            |         |
| High, 8–12                            | 30.97           | 36.91              |            |         |
| Confident can protect household from Zika virus infection |               |                    | 1.26       | 0.53    |
| Little or not confident                | 27.43           | 21.48              |            |         |
| Somewhat                              | 49.56           | 53.02              |            |         |
| Very                                  | 23.01           | 25.50              |            |         |
| Take action to protect oneself         |                 |                    | 1.42       | 0.23    |
| No                                    | 40.71           | 33.56              |            |         |
| Yes                                   | 59.29           | 66.44              |            |         |
| Perceived severity of Zika virus infection |               |                    | 4.81       | 0.09    |
| Little or no                          | 7.08            | 9.40               |            |         |
| Somewhat                              | 50.44           | 36.91              |            |         |
| Very                                  | 42.48           | 53.69              |            |         |
| Perceived severity of microcephaly    |                 |                    | 5.71       | <0.05   |
| Little or no severity                 | 29.20           | 18.24              |            |         |
| Somewhat                              | 41.59           | 54.73              |            |         |
| Very                                  | 29.20           | 27.03              |            |         |
| Likely to contract Zika virus infection |               |                    | 6.15       | <0.04   |
| Very unlikely                         | 50.44           | 43.62              |            |         |
| Somewhat unlikely                     | 30.97           | 44.97              |            |         |
| Very likely                           | 18.58           | 11.41              |            |         |
| Benefits of taking action to prevent Zika virus infection | | | 2.94 | 0.08 |
| No                                    | 38.94           | 28.86              |            |         |
| Yes                                   | 61.06           | 71.14              |            |         |
| Cues to action (know someone who is pregnant) | | | 1.28 | 0.25 |
| No                                    | 89.38           | 484.56             |            |         |
| Yes                                   | 10.62           | 15.44              |            |         |
| Employment status                     |                 |                    | 3.32       | 0.06    |
| In workforce                          | 74.34           | 63.76              |            |         |
| Not in workforce                      | 25.66           | 36.24              |            |         |
| Education                             |                 |                    | 0.17       | 0.67    |
| Less than bachelors                   | 49.56           | 46.98              |            |         |
| Bachelors or higher                   | 50.44           | 53.02              |            |         |
| Gross income level, USD               |                 |                    | 17.70      | <0.001  |
| <$50,000                              | 26.55           | 47.65              |            |         |
| $50,000-$100,000                      | 33.63           | 23.49              |            |         |
| >$100,000                             | 28.32           | 13.42              |            |         |
| Don’t know                            | 11.50           | 15.44              |            |         |

*USD, US dollar.