Awareness, Knowledge, and Travel-Related Risk Factors for Zika Virus Among Latinas Attending a Federally Qualified Health Center in Rural North Carolina

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BACKGROUND The Zika virus (ZIKV) epidemic that began in 2015 presented a risk for ZIKV infection among persons who traveled to ZIKV-affected countries. Latinas in North Carolina and their sexual partners may be exposed to ZIKV when traveling to these regions.

METHODS We administered a cross-sectional survey, measuring ZIKV risk and knowledge, to a convenience sample of 262 reproductive-age Latinas attending a Federally Qualified Health Center in rural North Carolina. We described ZIKV risk and knowledge in the sample, and compared responses between those who were pregnant or recently pregnant, and those who were not pregnant. We further identified factors associated with 1) awareness of ZIKV and 2) high knowledge of ZIKV sequelae and prevention among those who were aware of ZIKV, using log-binomial regression.

RESULTS Two-thirds of participants had ever heard of ZIKV, which was positively associated with educational attainment. Most participants aware of ZIKV had moderate/high knowledge of ZIKV transmission (92.5%) and symptoms (73.2%), but knowledge of preventing sexual and congenital transmission was limited. Travel was infrequent among pregnant or recently pregnant participants (5.4%) and their partners (7.1%). Despite low risk for ZIKV infection, participants were willing to practice ZIKV prevention.

LIMITATIONS Our study is limited by a lack of generalizability to Latinas in other regions of the country, self-reporting bias, and lack of survey validation as an indicator of English language proficiency.

CONCLUSIONS Providers should identify patients likely to become pregnant and travel to high-risk areas, inquire about partner travel history, and offer culturally appropriate ZIKV risk counseling.

Abstract: From 2015 through 2017, Zika virus (ZIKV) spread rapidly through 55 countries and territories in Latin America and the Caribbean [1]. In the United States, local mosquito-borne ZIKV cases were documented in South Florida and Brownsville, Texas, and 5,396 cases of ZIKV were reported in United States travelers returning from affected areas [2–4]. Although ZIKV is primarily spread to humans by infected Aedes aegypti mosquitoes, the recent ZIKV epidemic provided evidence for sexual and congenital ZIKV transmission [5, 6]. Congenital ZIKV transmission, from mother to fetus during pregnancy, can cause a constellation of neurologic, ophthalmologic, audiologic, and joint anomalies, which may be associated with profound and irreversible developmental deficits [7–9].

Although ZIKV transmission declined precipitously in Latin America and the Caribbean in 2017, sporadic ZIKV cases continue to be reported, and the Centers for Disease Control and Prevention (CDC) still recommends that pregnant women do not travel to most countries in the region [10]. Latinas living in the United States, especially recent immigrants, may be at higher risk for ZIKV due to personal or partner travel to visit relatives and friends in areas with recent mosquito-borne ZIKV transmission in Latin America and the Caribbean [11, 12]. Furthermore, the Aedes aegypti vector is present in a large portion of the Southern United States, and a future epidemic is possible in this region if ZIKV were imported by travelers [13]. Nearly 1 million Latino individuals reside in North Carolina, which has experienced a large influx of immigration from Latin America since 2010 [14]. At the height of the ZIKV epidemic in 2016, North Carolina identified 100 cases of ZIKV, accounting for 2% of all US cases reported that year [3].

Despite the potential severe consequences of congenital ZIKV infection, few studies have examined the risk and knowledge of ZIKV transmission and prevention among Latinas living in the United States to assess their unique travel-related risk factors [15–17]. This study surveyed Latinas of reproductive age attending a Federally Qualified Health Center (FQHC) in a rural county in central North Carolina. Our primary aim was to assess ZIKV risk factors, exposure to information about ZIKV, and knowledge of ZIKV.
transmission, acute ZIKV symptoms, and prevention methods in this potentially vulnerable population. An additional aim was to determine whether risk factors differed between those who were pregnant or recently pregnant (and at risk for the most severe consequences of ZIKV infection), and those who were not pregnant.

Methods

Participants

In this cross-sectional study, we recruited a convenience sample of participants from a rural FQHC in central North Carolina. Study staff reviewed the health center’s electronic health records to identify patients meeting the following eligibility criteria: (a) female, (b) Latina ethnicity, and (c) aged 18–50 years old. From April 6, 2017, through May 11, 2018, bilingual research assistants visited the FQHC once or twice a week to recruit participants. Research assistants approached eligible patients in the waiting room or exam room to complete an anonymous survey about ZIKV risk factors and knowledge. Patients who consented to participate and those who declined to participate received an alert message in their charts to avoid being approached again.

Data Collection and Measures

Our survey was adapted from a survey on ZIKV knowledge, risk perceptions, and behavioral intentions developed by experts in health behavior research [18]. The survey was translated into Spanish, proofread by 2 native Spanish speakers, and piloted with 10 sample patients at a separate FQHC serving a similar Latina population. Participants chose to complete the survey in Spanish or English. Research assistants administered the survey to participants who were unable to read, while participants who could read self-administered the survey. We stratified the sample into groups of pregnant and non-pregnant participants, as we hypothesized that pregnant women would have greater awareness of ZIKV or might take more precautions against ZIKV infection.

The survey captured information on participant sociodemographic characteristics (including age, marital status, country of birth, educational attainment, employment status, and insurance status), having seen or heard information about ZIKV (ie, awareness of ZIKV), sources of information about ZIKV, knowledge of ZIKV transmission and acute ZIKV symptoms, the likelihood of using currently available methods to prevent ZIKV, and risk factors for ZIKV infection (see Appendix in online version). We assessed sources of information about ZIKV among participants who reported awareness of ZIKV through a series of multiple-choice items. We assessed ZIKV knowledge and likelihood of using ZIKV prevention methods among participants who reported awareness of ZIKV, using a series of true/false, fill in the blank, and multiple-choice items. Knowledge items were grouped into 4 categories: ZIKV transmission routes (6 items), acute ZIKV symptoms (6 items), ZIKV sequelae and management during pregnancy (7 items), and prevention of sexual and congenital transmission of ZIKV (2 items). Likelihood of using any of 9 currently available ZIKV prevention methods (ie, using mosquito repellant; wearing long sleeves and pants; using air conditioning and window/door screens to keep mosquitoes outside; treating clothing with insecticides; avoiding casual interpersonal contact; sleeping under a bed net; staying sober to avoid unprotected sex with someone who may be infected with ZIKV; avoiding sex with someone who recently traveled to a ZIKV-affected area; and using condoms when having sex with someone who recently traveled to a ZIKV-affected area) was measured using a 6-point Likert scale with the following responses: “very unlikely,” “unlikely,” “neither likely nor unlikely,” “likely,” “very likely,” or “don’t know.”

Upon completing the survey, participants received a $5 gift card. Research assistants then reviewed the correct answers to the knowledge items with the participants and gave them a CDC handout on risks for ZIKV infection and prevention in their preferred language.

Statistical Analysis

We tabulated the participants’ characteristics, reported sources of information about ZIKV, and preferred information sources, stratified by pregnancy status. We then calculated knowledge of ZIKV and likelihood of using currently available ZIKV prevention methods among participants who reported awareness of ZIKV, also stratified by pregnancy status. Participants with greater than the median number of correct responses among all participants were deemed to have “high” knowledge. We also assessed knowledge by the language in which the survey was completed, to generate hypotheses about the role of English proficiency in ZIKV knowledge. Participants were deemed “likely” to use currently available ZIKV prevention methods if they reported being “likely” or “very likely” to use at least one method, and “unlikely or unsure” if they provided any other response. Responses to knowledge or likelihood items to which the participant responded “don’t know” were excluded. We used the Mantel-Haenszel chi-squared test to identify statistically significant differences in participant characteristics, knowledge of ZIKV, and likelihood of using currently available ZIKV prevention measures between pregnant and non-pregnant women ($\alpha = 0.05$).

Next, we searched for factors associated with 2 outcomes: 1) awareness of ZIKV versus lack of awareness (among all participants), and 2) high versus low knowl-
edge of ZIKV sequelae and management during pregnancy (among participants who reported awareness of ZIKV). We chose this knowledge category because it assessed more complex aspects of ZIKV that may not be common knowledge in the general population. We identified factors of interest on the basis of a priori hypotheses. We hypothesized that pregnancy status and birth outside of the United States was associated with increased awareness and knowledge of ZIKV, as pregnancy and travel were associated with adverse ZIKV outcomes. Educational attainment had been associated with ZIKV awareness and knowledge in prior studies [16], and we assessed marital status as a possible proxy for pregnancy intentions. We also hypothesized that discussing ZIKV with a medical provider, having a high likelihood of using ZIKV prevention methods, and having heard messages about ZIKV would be associated with increased ZIKV knowledge. We used log-binomial regression to estimate prevalence ratios (PR) and 95% confidence intervals (CI) for associations between these factors and outcomes of interest. All analyses were conducted in SAS version 9.4 (SAS Institute, Cary, North Carolina).

This research was reviewed and approved by the Institutional Review Board of the University of North Carolina at Chapel Hill.

Results

In total, 284 patients were invited to participate. Of these, 262 patients (92%) provided informed consent and responded to the survey; 29% were pregnant, and 71% were not pregnant. Ten participants were unable to read.

The median age of participants was 32 years (interquartile range: 26–39 years), and most were married (46%), or single but in a relationship (38%) (Table 1). Most participants were foreign-born (87%), of whom 83% were born in Mexico, and 77% of participants completed the survey in Spanish. One-half of participants had less than a high school education; most were unemployed (52%) and uninsured (73%). Marital status, place of birth, survey language, educational attainment, and insurance status were comparable between pregnant and non-pregnant women. Pregnant women tended to be younger than non-pregnant women (P < .0001) and were more likely to be unemployed or on maternity leave than non-pregnant women (P = .0001) (Table 1).

Pregnant and non-pregnant participants were equally aware of ZIKV (63%). Most participants received ZIKV information from television news, followed by the internet, social media, friends or family, and radio news (Figure 1a). We found no statistically significant differences in information sources between pregnant and non-pregnant participants, on the basis of overlapping 95% error bars. When given a choice among email, phone, social media, postal mail, and “other” sources, pregnant and non-pregnant participants indicated that social media was the best way to provide ZIKV information to the Latinx community (Figure 1b). Non-pregnant participants were significantly more likely to prefer social media, email, and “other” sources (ie, in-person communications, group meetings, news reports) than pregnant participants, whereas pregnant participants were significantly more likely to prefer phone and postal mail.

Most participants had low knowledge of ZIKV transmission routes and acute ZIKV symptoms, with no significant differences between pregnant and non-pregnant participants (Table 2). No participants had high knowledge of prevention of sexual and congenital ZIKV transmission; only 16 participants had some knowledge and the rest had none (Table 2). Roughly equal proportions of participants had high and low knowledge of ZIKV sequelae and management during pregnancy (Table 2). In 2 knowledge categories, participants who completed the survey in Spanish were less likely to achieve a high knowledge score than those who completed the survey in English: sexual and congenital transmission (7% versus 18%, P = .04) and ZIKV sequelae and management during pregnancy (43% versus 68%, P = .007). Overall, knowledge of ZIKV in the 4 subject categories was not significantly different between pregnant and non-pregnant participants.

Having at least a high school education versus having less than a high school education was significantly associated with awareness of ZIKV (PR: 1.23, 95% CI: 1.02, 1.49) (Table 3). Pregnancy status, country of birth, and marital status were not associated with ZIKV awareness. Among participants who were aware of ZIKV, we identified no factors that were significantly associated with high knowledge of ZIKV sequelae and management during pregnancy.

Among participants who were pregnant or who had given birth since January 1, 2015, 5% reported foreign travel during or 2 months prior to their current or most recent pregnancy. Seven percent reported foreign travel by a sexual partner during or in the 6 months prior to their current or most recent pregnancy (Table 4). All travel among participants and their sexual partners was to Mexico. Six percent of pregnant women reported having more than one sexual partner during pregnancy. Most participants (72%) had unprotected sex during pregnancy, and 16% planned to become pregnant again within the next 5 years (Table 4).

Discussion

In a sample of reproductive-age Latinas seeking health care at a FQHC in rural North Carolina, two-thirds reported ZIKV awareness, and higher educational attainment was significantly associated with ZIKV awareness. Although most participants in our sample were aware of ZIKV, knowledge about ZIKV prevention, specifically regarding sexual and congenital transmission, was low. Participants who completed the survey in Spanish were less likely to know how to prevent sexual and congenital ZIKV transmission than those who completed the survey in English. Most participants, however, expressed willingness to use currently
available methods to prevent ZIKV infection. These findings can guide clinicians and public health educators in providing appropriate risk-based ZIKV prevention counseling, particularly in rural Latinx communities in North Carolina.

These results are consistent with those from prior studies, which found low ZIKV knowledge across the United States and among Latinx participants [16, 19, 20]. Notably, they found low knowledge regarding sexual transmission and ZIKV prevention methods, such as preventing mosquito bites and using condoms during sex [15, 21, 22]. In our study, we had hypothesized that women who stand to benefit the most from ZIKV prevention (ie, pregnant) and those who are most frequently exposed to communications about ZIKV would have greater knowledge of its long-term consequences and how to manage ZIKV risk during pregnancy. Our data suggest, however, that these individuals are not more likely to receive or retain more complex information about ZIKV. Future research is needed to better understand factors asso-

| Characteristic                        | Overall (N = 262) | Pregnant women (N = 75) | Non-pregnant women (N = 187) | P*  |
|--------------------------------------|------------------|-------------------------|------------------------------|-----|
| Age, years (median, interquartile range) | 32 (26-39)       | 30 (23-33)              | 34 (27-41)                   | <0.0001 |
| Marital status                       |                  |                         |                              |     |
| Single, not in relationship          | 37 (14.3)        | 10 (13.3)               | 27 (14.7)                    | 0.4 |
| Single, in relationship              | 98 (37.8)        | 32 (42.7)               | 66 (35.9)                    |     |
| Married                              | 119 (46.0)       | 33 (44.0)               | 86 (46.7)                    |     |
| Divorced                             | 5 (1.9)          | 0 (0.0)                 | 5 (2.7)                      |     |
| Missing                              | 3                | -                       | 3                            |     |
| Birthplace                           |                  |                         |                              |     |
| United States                        | 34 (13.0)        | 7 (9.3)                 | 27 (14.4)                    | 0.3 |
| Outside the United Statesb           | 228 (87.0)       | 68 (90.7)               | 160 (85.6)                   |     |
| Language of survey                   |                  |                         |                              |     |
| English                              | 60 (22.9)        | 22 (20.3)               | 38 (20.3)                    | 0.1 |
| Spanish                              | 202 (77.1)       | 53 (70.7)               | 149 (79.7)                   |     |
| Educational attainment               |                  |                         |                              |     |
| Some primary education               | 25 (9.6)         | 6 (8.0)                 | 19 (10.2)                    | 0.2 |
| Completed primary education          | 45 (17.2)        | 9 (12.0)                | 36 (19.3)                    |     |
| Some middle school or high school    | 58 (22.2)        | 17 (22.7)               | 41 (21.9)                    |     |
| Completed high school or GED         | 104 (39.9)       | 37 (49.3)               | 67 (35.8)                    |     |
| Completed associate degree           | 18 (6.9)         | 3 (3.0)                 | 15 (8.0)                     |     |
| Completed bachelor’s degree          | 10 (3.8)         | 2 (2.7)                 | 8 (4.3)                      |     |
| Completed master’s or doctoral degree| 1 (0.4)          | 1 (1.3)                 | 0 (0.0)                      |     |
| Missing                              | 1                | -                       | 1                            |     |
| Employment status                    |                  |                         |                              |     |
| Full-time                            | 73 (28.7)        | 15 (20.8)               | 58 (31.9)                    | 0.0001 |
| Part-time                            | 41 (16.1)        | 9 (12.5)                | 32 (17.6)                    |     |
| Unemployed                           | 133 (52.4)       | 41 (56.9)               | 92 (50.5)                    |     |
| Temporary maternity leave            | 7 (2.8)          | 7 (9.7)                 | 0 (0.0)                      |     |
| Missing                              | 8                | 3                       | 5                            |     |
| Insurance status                     |                  |                         |                              |     |
| Insured                              | 56 (21.6)        | 15 (20.3)               | 41 (22.2)                    | 0.8 |
| Uninsured                            | 190 (73.4)       | 56 (75.7)               | 134 (72.4)                   |     |
| Don’t know                           | 13 (5.0)         | 3 (4.0)                 | 10 (5.4)                     |     |
| Missing                              | 3                | 1                       | 2                            |     |
| Discussed ZIKV with a medical profes|                  |                         |                              |     |
| No                                   | 213 (95.5)       | 59 (93.7)               | 154 (96.3)                   | 0.4 |
| Yes                                  | 10 (4.5)         | 4 (6.3)                 | 6 (3.7)                      |     |
| Missing                              | 39               | 12                      | 27                           |     |

Abbreviations: GED=general educational development; ZIKV = Zika virus

bP-value for comparison between pregnant and non-pregnant women. Bold values are statistically significant at α = 0.05.

bParticipants reported countries of birth as Mexico, Guatemala, Honduras, El Salvador, or other.
associated with high ZIKV knowledge. Nevertheless, our findings highlight opportunities to provide bilingual ZIKV information to reach Spanish-dominant Latinx communities in North Carolina, and to leverage social media, television news, and the internet to disseminate information about ZIKV.

Some participants received ZIKV prevention counseling from their health care providers. Among the 10 participants who reported discussing their travel plans with a provider, 8 received advice about preventing ZIKV, and 6 could recall specific messages (eg, using insect repellent or avoiding travel altogether). Studies on information dissemination, however, have shown that public service announcements, such as travel advisories from the World Health Organization and CDC, are more common sources of information about ZIKV than clinician counseling [23, 24]. Nevertheless, few local media outlets and public service officials had provided information on ZIKV in rural North Carolina, potentially limiting ZIKV awareness in our study population. Given that 86% of participants were willing to engage in preventive practices against ZIKV transmission, dissemination of messages through information channels preferred by the target audience and subsequently improv-

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**FIGURE 1.**
Current and Preferred Sources of Information about Zika Virus Among Latinas Attending a Federally Qualified Health Center in North Carolina (N = 165)

**Figure 1a. Current Sources of Information**

| Information Sources | Percent | Non-pregnant (N=118) | Pregnant (N=47) |
|---------------------|---------|----------------------|-----------------|
| Television news     |         | 0.185 (0.03)        | 0.20 (0.03)     |
| Internet            |         | 0.42 (0.04)         | 0.30 (0.03)     |
| Social media        |         | 0.29 (0.03)         | 0.25 (0.03)     |
| Friends or family   |         | 0.17 (0.03)         | 0.13 (0.03)     |
| Radio news          |         | 0.04 (0.03)         | 0.00 (0.00)     |
| Newspaper           |         | 0.04 (0.03)         | 0.00 (0.00)     |
| Schools or academic institutions | | | |
| Workplace           |         | 0.04 (0.03)         | 0.00 (0.00)     |
| Airport             |         | 0.00 (0.00)         | 0.00 (0.00)     |
| None of the above   |         | 0.00 (0.00)         | 0.00 (0.00)     |

**Figure 1b. Preferred Sources of Information**

| Information Sources | Percent | Non-pregnant (N=118) | Pregnant (N=47) |
|---------------------|---------|----------------------|-----------------|
| Social media        |         | 0.43 (0.05)         | 0.36 (0.05)     |
| Phone               |         | 0.30 (0.05)         | 0.25 (0.05)     |
| Postal mail         |         | 0.13 (0.04)         | 0.12 (0.04)     |
| Other               |         | 0.03 (0.03)         | 0.01 (0.01)     |
| Email               |         | 0.00 (0.00)         | 0.00 (0.00)     |

Note. Includes in-person communications (N = 3); community meetings (N = 3); receiving information during a health encounter (N = 2); television (N = 1); unspecified (N = 2).
ing ZIKV knowledge may result in the successful adoption of ZIKV prevention behaviors.

We were surprised to find a low frequency of recent travel outside of the United States among participants and their partners, and thus a low risk of mosquito-borne ZIKV transmission in our sample. Nevertheless, the American College of Obstetricians and Gynecologists recommends that providers routinely inquire about patients’ travel history during preconception counseling and throughout prenatal care, and the CDC released interim guidance recommending condoms or abstinence for couples who are not planning pregnancy if a male partner had a possible ZIKV exposure [25, 26]. While few cases of ZIKV in North Carolina have been reported since 2016, global outbreaks of ZIKV continue to occur, including a recent outbreak in India for which the CDC has issued a temporary travel advisory [27]. Furthermore, there are well-documented structural barriers and social vulnerabilities that prevent Latinas from accessing prenatal care and contraception counseling, including limited English proficiency, lack of health insurance, concerns about legal status, transportation difficulties, and poverty [29–31]. Therefore, public health messaging that is targeted and easily accessible may fill an important knowledge gap among Latinas who do not regularly access medical care. We found that social media was the preferred mode of receiving these communications. Communications that are optimized for mobile devices—including social media posts, mobile apps, and text messages—may be effective in promoting healthy behaviors when planning travel to areas with local ZIKV transmission. Culturally adapted mobile health tools used for other prevention efforts may be helpful to broaden the reach of existing ZIKV prevention materials [32–35].

It is important to note that immigrants traveling to their countries of birth to visit relatives and friends may be less likely to seek care in a travel medicine clinic or practice preventive behaviors to reduce health risks during travel [28].

| TABLE 2. Knowledge and Behaviors Related to ZIKV Prevention Among Latinas Attending a Federally Qualified Health Center in North Carolina (N = 165) |
|---------------------------------|-----------------|-----------------|-----------------|
|                                  | Pregnant women  | Non-pregnant women | p^b               |
|                                  | (N = 47)        | (N = 118)         |                  |
| Knowledge - ZIKV transmission routes (6 items) |                  |                  |                  |
| Low knowledge (0-4 correct)      | 28 (62.2)       | 57 (50.0)        | 0.2              |
| High knowledge (5-6 correct)     | 17 (37.8)       | 57 (50.0)        |                  |
| Missing (N = 6)                  |                  |                  |                  |
| Knowledge - ZIKV symptoms (6 items) |                  |                  |                  |
| Low knowledge (0-3 correct)      | 30 (63.8)       | 69 (59.0)        | 0.6              |
| High knowledge (4-6 correct)     | 17 (36.2)       | 48 (41.0)        |                  |
| Missing (N = 1)                  |                  |                  |                  |
| Knowledge - ZIKV sequelae and management in pregnancy (7 items) |                  |                  |                  |
| Low knowledge (0-2 correct)      | 25 (53.2)       | 59 (50.0)        | 0.7              |
| High knowledge (3-7 correct)     | 22 (46.8)       | 59 (50.0)        |                  |
| Knowledge - Preventing sexual and congenital ZIKV transmission (2 items) |                  |                  |                  |
| Low/no knowledge (0 correct)     | 40 (87.0)       | 108 (91.5)       | 0.4              |
| Some knowledge (1 correct)       | 6 (13.0)        | 10 (8.5)         |                  |
| Missing (N = 1)                  |                  |                  |                  |
| Likelihood of using currently available ZIKV prevention methods^c |                  |                  |                  |
| Likely                           | 42 (89.4)       | 99 (83.9)        | 0.4              |
| Unlikely or unsure               | 5 (10.6)        | 19 (16.1)        |                  |

Abbreviations: ZIKV = Zika virus
^aAmong 165 women who reported having ever heard any information about ZIKV.
^bP-value for comparison between pregnant and non-pregnant women. Bold values are statistically significant at α = 0.05.
^cPrevention methods include: using mosquito repellent; wearing long sleeves and pants; using air conditioning and window/door screens to keep mosquitoes outside; treating clothing with insecticides; avoiding casual interpersonal contact; sleeping under a bed net; staying sober to avoid unprotected sex with someone who may be infected with ZIKV; avoiding sex with someone who recently traveled to a ZIKV-affected area; using condoms when having sex with someone who recently traveled to a ZIKV-affected area.
backgrounds who originate from countries with mosquito-borne ZIKV transmission, a population that has been under-represented in the current literature. Furthermore, limited studies have focused on partner travel history with regard to ZIKV risk and transmission. Our study is limited by lack of generalizability to Latinas in other regions of the country. For example, it is possible that some participants in our sample could not legally leave and re-enter the United States, and therefore, we may have underestimated the travel-related ZIKV risk as compared to that of US Latinas as a whole.

### Table 3.
**Predictors of ZIKV Awareness and Knowledge Among Latinas Attending a Federally Qualified Health Center in North Carolina**

### Outcome: Ever heard information about ZIKV (N = 262)

| Predictor                              | N (%)    | Crude Prevalence Ratio (95% Confidence Interval) |
|----------------------------------------|----------|--------------------------------------------------|
| Pregnancy status                       |          |                                                  |
| Not pregnant                           | 118 (63.1) | Referent                                         |
| Pregnant                               | 47 (26.7)  | 0.99 (0.81, 1.22)                                |
| Educational attainment                 |          |                                                  |
| Less than high school diploma          | 72 (56.3)  | Referent                                         |
| High school diploma or post-secondary  | 93 (69.4)  | 1.23 (1.02, 1.49)                                |
| Birthplace                             |          |                                                  |
| United States                          | 143 (62.7) | Referent                                         |
| Outside the United States              | 22 (64.7)  | 1.03 (0.79, 1.35)                                |
| Marital status                         |          |                                                  |
| Single, not in relationship            | 19 (51.4)  | Referent                                         |
| Single, in relationship                | 63 (64.3)  | 1.25 (0.89, 1.77)                                |
| Married                                | 77 (64.7)  | 1.26 (0.90, 1.77)                                |
| Divorced                               | 3 (60.0)   | 1.17 (0.53, 2.55)                                |

### Outcome: High knowledge of ZIKV* (N = 165)

| Predictor                              | N (%)    | Crude Prevalence Ratio (95% Confidence Interval) |
|----------------------------------------|----------|--------------------------------------------------|
| Pregnancy status                       |          |                                                  |
| Not pregnant                           | 59 (50.0)  | Referent                                         |
| Pregnant                               | 22 (46.8)  | 0.94 (0.66, 1.33)                                |
| Educational attainment                 |          |                                                  |
| Less than high school diploma          | 31 (43.1)  | Referent                                         |
| High school diploma or post-secondary  | 50 (53.8)  | 1.25 (0.90, 1.73)                                |
| Birthplace                             |          |                                                  |
| United States                          | 14 (63.6)  | Referent                                         |
| Outside the United States              | 67 (46.9)  | 1.36 (0.95, 1.95)                                |
| Discussed ZIKV with medical professional |        |                                                  |
| No                                     | 76 (49.4)  | Referent                                         |
| Yes                                    | 4 (44.4)   | 0.90 (0.42, 1.90)                                |
| Marital status                         |          |                                                  |
| Single, not in relationship            | 9 (47.4)   | Referent                                         |
| Single, in relationship                | 34 (54.0)  | 1.14 (0.67, 1.93)                                |
| Married                                | 37 (48.1)  | 1.01 (0.60, 1.72)                                |
| Divorced                               | 1 (33.3)   | 0.70 (0.13, 3.73)                                |
| Likelihood of using currently available ZIKV preventive measures** | | |
| Unlikely or unsure                     | 7 (29.2)   | Referent                                         |
| Likely                                 | 74 (52.5)  | 1.80 (0.95, 3.42)                                |
| How often seen messages about ZIKV     |          |                                                  |
| Once per month or more                 | 51 (49.5)  | Referent                                         |
| Less than once per month or none       | 30 (48.4)  | 0.98 (0.71, 1.35)                                |

*Abbreviations: ZIKV = Zika virus

*Knowledge of ZIKV sequelae and management during pregnancy, dichotomized as high versus low.

**Dichotomized as likely or very likely versus very unlikely, unlikely, neither likely nor unlikely, or don’t know.

*Prevention methods include: using mosquito repellent; wearing long sleeves and pants; using air conditioning and window/door screens to keep mosquitoes outside; treating clothing with insecticides; avoiding casual interpersonal contact; sleeping under a bed net; staying sober to avoid unprotected sex with someone who may be infected with ZIKV; avoiding sex with someone who recently traveled to a ZIKV-affected area; using condoms when having sex with someone who recently traveled to a ZIKV-affected area.
Additionally, we conducted our survey in 2017-2018, after the ZIKV epidemic had subsided, which may have contributed to low knowledge as a result of reduced intensity of public communications about ZIKV prevention. A potentially substantial limitation is self-reporting bias. It is possible that the participants may have under-reported travel or foreign-born status due to growing stigmatization of immigrants in the United States. Finally, we did not validate survey language as an indicator of English language proficiency, and the number of participants who completed the survey in Spanish potentially overestimates the degree of limited English proficiency in our sample [36].

Although the ZIKV epidemic has declined throughout Latin America and the Caribbean, most countries in the region are still considered at future risk for ZIKV transmission [1]. Latinx communities with large numbers of recent immigrants may be vulnerable to ZIKV infection during travel and may also suffer from low knowledge of ZIKV and ZIKV prevention. Medical providers serving predominantly Latinx immigrant communities should engage patients in discussions about ZIKV risk and prevention, and mass media and social media communications about ZIKV should be developed to reach these communities using their preferred languages and channels. The results of this study can inform efforts to prevent ZIKV in immigrant Latinx communities in North Carolina and the United States. 

**NCM**

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### Table 4

**Risk Factors for ZIKV Infection During Current or Most Recent Pregnancy** Among Latinas Attending a Federally Qualified Health Center in North Carolina (N = 130)

| Risks factors                                                                 | N (%) |
|--------------------------------------------------------------------------------|-------|
| **Respondent traveled outside of U.S. during pregnancy or in the 2 months before becoming pregnant** |       |
| Yes                                                                           | 7 (5.4) |
| No                                                                            | 122 (94.6) |
| Missing                                                                       | 1     |
| **Sex partner(s) traveled outside the U.S. during pregnancy or in the 6 months before becoming pregnant** |       |
| Yes                                                                           | 9 (71) |
| No or don’t know                                                              | 118 (92.9) |
| Missing                                                                       | 3     |
| **Number of male sex partners in the past 6 months (n = 75)**                 |       |
| 0                                                                             | 2 (2.7) |
| 1                                                                             | 69 (92.0) |
| 2-5                                                                           | 2 (2.7) |
| 6 or greater                                                                  | 2 (2.7) |
| **Respondent or sex partner(s) had unprotected sex during pregnancy**         |       |
| Yes                                                                           | 91 (71.7) |
| No                                                                            | 32 (25.2) |
| Don’t know                                                                    | 4 (3.1) |
| Missing                                                                       | 3     |
| **Respondent plans on another pregnancy in next 5 years**                     |       |
| Yes                                                                           | 20 (15.7) |
| No                                                                            | 66 (52.0) |
| Don’t know                                                                    | 41 (32.3) |
| Missing                                                                       | 3     |

**Abbreviations:** ZIKV = Zika virus; U.S. = United States

*Includes women reporting a current pregnancy or with a recent birth occurring since January 1, 2015.

*Restricted to women reporting a current pregnancy.*
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APPENDIX 1.
Survey of Travel-Related Risk Factors and Knowledge of Zika Virus in Latinas Attending a Federally Qualified Health Center in North Carolina

SECTION 1: PARTICIPANT CHARACTERISTICS
Q0 Language of survey
- English
- Spanish

Q1 Are you between the ages of 18 to 50?
- Yes
- No

Skip To: End of Survey if “Are you between the ages of 18 to 50?” = No

Q2 Can you read?
- Yes
- No

Q3 Age (eligible participants are 18-50 years of age)
Years _________________

Q4 Today’s Date (Date of survey)
Date (mm/dd/yyyy) _________________

Q5 What is your current marital status?
- Single, not in a relationship
- Single, in a relationship
- Married
- Divorced
- Widowed

Q6 Were you born outside of the United States?
- Mexico
- Guatemala
- Honduras
- El Salvador
- Other _________________
- No

Q7 What is your current insurance status?
- Insured
- Uninsured
- Don’t know

Q8 Of the following, what is the highest level of education you have completed?
- Some primary education
- Completed primary education (up to 6th grade)
- Some middle school or high school
- Completed high school or GED
- Completed associates degree (2 years)
- Completed 4-year degree (BA/BS)
- Completed master or doctoral degree

Q9 What is your current employment status:
- Employed full-time
- Employed part-time
- Unemployed
- Temporary maternity leave
### SECTION 2: TRAVEL-RELATED RISK FACTORS FOR ZIKA VIRUS

Questions designated “NP” are for participants who are not attending the health center for a prenatal visit.

Q10 **NP** Have you ever been pregnant?
- Yes
- No

*Skip To: Q19 if “Have you ever been pregnant?” = No*

Q11 **NP** What was your last child’s date of birth (mm/dd/yyyy) “if day not given, enter “01” for dd”

```
Date (mm/dd/yyyy) _________________
```

Q12 **NP** During your last pregnancy, have you traveled outside of the United States in the TWO months before you became pregnant?
- Yes _________________
- No

Q13 **NP** During your last pregnancy, have you traveled outside of the United States while you were pregnant?
- Yes _________________
- No

Questions designated “P” are for participants who are attending the health center for a prenatal visit.

Q10 **P** When did you find out you were pregnant? (mm/dd/yyyy)

```
Date (mm/dd/yyyy) _________________
```

Q11 **P** What is your expected date of delivery? (Mo/Day/Year)

```
Date (mm/dd/yyyy) _________________
```

Q12 **P** Have you traveled outside of the United States in the TWO months before you became pregnant?
- Yes _________________
- No

Q13 **P** During your pregnancy, have you traveled outside of the United States?
- Yes _________________
- No

Q14 **P** In the past six months, how many male sexual partners have you had?
- None
- 1
- 2-5
- 5-10
- Over 10

Q15 Has your sex partner(s) traveled outside of the United States in the SIX months before you found out you were pregnant?
- Yes _________________
- No
- Don’t Know

Q16 Has your sex partner(s) traveled outside of the United States during your pregnancy?
- Yes _________________
- No
- Don’t Know

Q17 Have you or your sex partner(s) had unprotected sex (sex without a condom) during your pregnancy?
- Yes
- No
- Don’t Know

Q18 Do you plan on being pregnant again in the next five years?
- Yes
- No
- Don’t Know
SECTION 3: KNOWLEDGE ABOUT ZIKA VIRUS

Q19 Have you seen or heard any information about the Zika virus?

☐ Yes
☐ No

Skip To: Q31 If “Have you seen or heard any information about the Zika virus?” = No

3.1: TRANSMISSION

Q20 To the best of your knowledge, which of the following ways can you get the Zika virus? Please check all that apply.

☐ Receiving a blood transfusion with blood that contains the Zika virus.
☐ Breathing the same air as a person who is sick from Zika.
☐ Being bitten by a mosquito that carries the Zika virus.
☐ Having sex with someone who is infected with the Zika virus.
☐ From a pregnant woman to her fetus (developing baby).
☐ Drinking unclean water.
☐ Don’t know

3.2: ACUTE SYMPTOMS

Q21 Which of the following are common symptoms of Zika? Please check all that apply:

☐ Fever
☐ Bloody cough
☐ Rash
☐ Joint and muscle pain
☐ Pink eye
☐ Diarrhea

3.3: SEXUAL AND VERTICAL TRANSMISSION

Q22 Fill in the blank: To protect their partners from getting the Zika virus, men who are possibly infected with Zika should use a condom for at least ______ months, even if they had no symptoms.

☐ 1
☐ 2
☐ 4
☐ 6
☐ 12
☐ Don’t know

Q23 Fill in the blank: Women who may have been exposed to Zika should wait ______ months before trying to get pregnant.

☐ 1
☐ 2
☐ 4
☐ 6
☐ 12
☐ Don’t know

3.4: ZIKA SEQUELAE AND MANAGEMENT IN PREGNANCY

Q24 Please select TRUE, FALSE, or DON’T KNOW for each of the following phrases about the Zika virus:

| True | False | Don’t Know |
|------|-------|-----------|
| If a pregnant woman becomes infected with the Zika virus, her baby will always be infected. | o | o | o |
| The Zika virus can cause brain or birth defects in developing babies. | o | o | o |
| The Zika virus can cause diarrhea in adults. | o | o | o |
| Someone can have the Zika virus and not have any symptoms | o | o | o |

Q24 Please select TRUE, FALSE or DON’T KNOW for the following phrases about the Zika virus:

| True | False | Don’t Know |
|------|-------|-----------|
| Pregnant women who have visited a Zika-affected area should be tested for Zika whether or not they have symptoms. | o | o | o |
| Public health officials say that insecticides containing DEET are safe for pregnant women to use to prevent Zika. | o | o | o |
| Zika cannot be transmitted by sex if a woman is pregnant | o | o | o |
SECTION 4: SOURCES OF INFORMATION ABOUT ZIKA VIRUS

Q26 In the last three months, how often have you seen, heard or read any messages about how to prevent Zika? Please select one answer.

☐ Several times per week
☐ About once per week
☐ About once per month
☐ Less often than once per month
☐ I have not seen any messages

Q27 Where did you see, hear or read messages about how to prevent Zika? Please check all that apply.

☐ Internet
☐ Social media
☐ TV news
☐ Radio news
☐ Newspapers
☐ Schools/universities or colleges
☐ Workplace
☐ Airport
☐ Friends/Family
☐ None of these

Q28 In your opinion, what is the best way to contact Latina women about the risk of Zika?

☐ By e-mail
☐ By Facebook, Twitter, or other social media site
☐ By phone
☐ By mail
☐ Other ________________________________
### SECTION 5: CURRENTLY-AVAILABLE ZIKA PREVENTION METHODS

Q29 To the best of your knowledge, how effective do you think each of the following are in protecting someone from Zika?

| Method                                                                 | Very effective | Effective | Neither effective nor uneffective | Uneffective | Very uneffective | Don’t know |
|------------------------------------------------------------------------|----------------|-----------|----------------------------------|-------------|-----------------|------------|
| Using mosquito repellent                                               | ○              | ○         | ○                                | ○           | ○               | ○          |
| Wearing long sleeved shirts and long pants                             | ○              | ○         | ○                                | ○           | ○               | ○          |
| Staying in places with air conditioning, window screens, and door screens to keep mosquitoes outside | ○              | ○         | ○                                | ○           | ○               | ○          |
| Sleeping under a bed net                                               | ○              | ○         | ○                                | ○           | ○               | ○          |
| Not having casual contact (eg, shaking hands) with anyone              | ○              | ○         | ○                                | ○           | ○               | ○          |
| Not having unprotected sex with someone who is in or has recently traveled to an area with Zika | ○              | ○         | ○                                | ○           | ○               | ○          |
| Staying sober to avoid casual sex without a condom with someone who is in or has recently traveled to an area with Zika | ○              | ○         | ○                                | ○           | ○               | ○          |
| Using condoms with someone who is in or has recently traveled to an area with Zika | ○              | ○         | ○                                | ○           | ○               | ○          |

Q30 Realistically, how likely are you to do the following to prevent Zika?

| Method                                                                 | Very effective | Effective | Neither effective nor uneffective | Uneffective | Very uneffective | Don’t know |
|------------------------------------------------------------------------|----------------|-----------|----------------------------------|-------------|-----------------|------------|
| Using mosquito repellent                                               | ○              | ○         | ○                                | ○           | ○               | ○          |
| Wearing long sleeved shirts and long pants                             | ○              | ○         | ○                                | ○           | ○               | ○          |
| Staying in places with air conditioning, window screens, and door screens to keep mosquitoes outside | ○              | ○         | ○                                | ○           | ○               | ○          |
| Sleeping under a bed net                                               | ○              | ○         | ○                                | ○           | ○               | ○          |
| Not having casual contact (eg, shaking hands) with anyone              | ○              | ○         | ○                                | ○           | ○               | ○          |
| Not having unprotected sex with someone who is in or has recently traveled to an area with Zika | ○              | ○         | ○                                | ○           | ○               | ○          |
| Staying sober to avoid casual sex without a condom with someone who is in or has recently traveled to an area with Zika | ○              | ○         | ○                                | ○           | ○               | ○          |
| Using condoms with someone who is in or has recently traveled to an area with Zika | ○              | ○         | ○                                | ○           | ○               | ○          |
SECTION 6: DISCUSSING ZIKA WITH A HEALTH CARE PROVIDER

Q31 Have you discussed your travel plans with a health care provider?
   □ Yes
   □ No

Q32 If yes, what did your provider tell you about to prevent Zika?
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________