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U.S. Pregnant Women's Knowledge and Attitudes about Behavioral Strategies and Vaccines to Prevent Zika Acquisition

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INTRODUCTION

Zika virus is part of the virus family *Flaviviridae* that can be carried by *Aedes* mosquitoes.^{1,2,3} Since 2015, the virus has spread quickly in the tropical regions of the Americas.^{4,5,6} Transmission of Zika virus can occur through serum, prenatally, or sexually.^{7,8,9} The majority of infected adults are asymptomatic.^{10,11} If they do present symptoms, the symptoms commonly are mild and include joint pain, conjunctivitis, and rash or a fever that lasts two to seven days.^{12,13} However, the infection can have severe consequences when transmitted perinatally.^{5,9,14} In March 2016, the World Health Organization (WHO) reported that Zika virus infections during pregnancy can cause neonatal microcephaly and other congenital birth disorders.¹⁵ Thus, prevention of Zika infection during pregnancy is of high importance. As of July 5th 2017, the Centers for

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Disease Control and Prevention (CDC) had documented a total of 663 symptomatic Zika cases in the United States (U.S.) and territories.¹⁶

The WHO has listed developing a Zika vaccine as a top research priority.¹⁷ Vaccination is among the most successful public health strategies, and is a priority for prevention of congenital Zika, given the severity of the disease and that mosquito-borne infections are hard to prevent through other interventions.¹⁸ Until a vaccine is available, women will need to rely on other methods to prevent sexual or mosquito transmission.¹⁹

Given the severity of neonatal infection and the promise of a vaccine, it is timely to assess pregnant women's attitudes about Zika prevention. Previous research has found gaps in knowledge about transmission, including sexual transmission, and vaccine acceptability ranged from 21% of pregnant women in Greece to 56% of female college students in Virginia.^{20, 21} We extended this research by drawing on a national sample of pregnant women in the U.S. to understand: 1) pregnant women's attitudes and knowledge about Zika virus, 2) factors associated with perceptions of their ability to implement behavioral strategies to prevent Zika acquisition during pregnancy, and 3) factors associated with their willingness to receive a Zika vaccine if one were developed and available.

MATERIALS AND METHODS

A U.S. national sample of pregnant women (N = 362) completed an online survey addressing attitudes about health during pregnancy. Responses were collected from November 8th to November 16th, 2016. Eligibility criteria included being pregnant and over the age of 18 years, living in the U.S., and speaking Spanish or English. Participants were enrolled through Survey Sampling International (SSI)²² a survey research company that maintains a national panel of over four million individuals in the United States. Respondents were compensated \$10.00 worth of SSI panel account incentives. A study information sheet was presented and participants indicated informed consent to participate by initiating survey responses. All recruitment and study procedures were approved by the Columbia University Medical Center Institutional Review Board.

Questionnaire

Socio-demographic information included age category, race-ethnicity, relationship status, pregnancy and sexually transmitted infection (STI) history. Each woman was asked if she had lived in or traveled to a place where she could acquire a Zika infection. We also asked participants to indicate their general perceived level of Zika knowledge on a four-point scale, and worry about Zika on a three-point Likert-type scale.

Race-ethnicity was coded as Hispanic, non-Hispanic White, non-Hispanic African-American, non-Hispanic Other, and non-Hispanic multi-racial. For purposes of predictive analyses, the five women who were non-Hispanic multi-racial were excluded. Relationship with the father of the baby (FOB) was collapsed as follows: being married or living together, being together but not living together, and not being together.

We assessed factual knowledge of Zika with eight statements for which the response options were “yes”, “no”, or “I don’t know”. Six statements asked about the route of transmission of the virus (i.e., mosquito bites, sharing drinks, perinatal acquisition, shaking hands, sexual transmission, and sneezing). One statement assessed the severity of the virus for adults (i.e., having mild symptoms) and one additional question relating to sexual transmission (i.e., men can have it remain in semen for an unknown period). “I don’t know” responses were scored as incorrect.

After completion of the knowledge portion, the following brief informational paragraph was provided: *If a pregnant woman gets Zika either through a mosquito bite or from sex, the baby can have serious developmental problems including a small head, and brain and eye abnormalities. At the moment, there is no treatment for Zika for a pregnant woman and no vaccine to prevent infection.*

Six subsequent items measured how difficult it would be (not at all hard, somewhat hard, very hard) for participants to prevent Zika during pregnancy using behavioral strategies (i.e., abstaining from sex, using condoms, not traveling to an area with Zika, their partner not traveling into an area with Zika, using mosquito repellent, wearing long pants and sleeves). In order to evaluate the difficulty of implementing the six behavioral strategies, the strategies were summed.

Three items assessed attitudes about vaccines for Zika (i.e., importance, vaccine strategy, vaccine acceptability). For predictive models, we dichotomized vaccine importance into very important and somewhat important versus not at all important.

Statistical Analysis

All statistical analyses were conducted using SAS 9.4 (SAS Institute Inc. Cary, NC, U.S.A.). Using linear models, we evaluated each predictor in bivariate models for associations with perceptions that the behavioral strategies were hard to do. Those that were significant at $p < 0.10$ were retained for a multivariable linear model with backwards elimination, for which the p was set at < 0.05 . In order to evaluate vaccine acceptability, we compared yes to no/not sure. Using logistic regression models, we evaluated the association of each predictor with vaccine acceptability in bivariate models. Those that were significant at $p < 0.10$ were retained for a multivariable logistic regression with backwards elimination, for which the p was set at < 0.05 .

As always with self-completed surveys, there was occasionally missing data. The number of missing responses did not exceed eight for all items; thus, the sample size of missing responses is not reported for each item in the results.

RESULTS

Sample

The majority of women (91%) were married or living with the father of the baby, 67% were 25–35 years, and 65% were non-Hispanic Caucasian. (Table 1) The respondents represented 43 states and Puerto Rico. Seventy-two percent reported that they either had not lived/

traveled or were not sure whether they had lived/traveled in an area with Zika, and 28% reported they had. Eight percent had “never heard about it”, 20% had “heard about it but didn’t know much about it”, 43% thought they knew “a little bit”, and 30% thought they “knew a lot”. Perceived knowledge was dichotomized into knowing less (i.e. “having never heard about it”/“having heard about it but not knowing much about it”/“knowing a little bit about it”) (70%), versus knowing a lot (30%). Overall, 26% reported not being worried about Zika, and 74% reported being very or somewhat worried.

The mean factual knowledge score was 5.0 out of 8 (SD = 2.09). Most answered correctly that mosquitos transmit Zika (87% correct), and most did not know that the virus could remain in the semen for an unknown period of time (49% correct) (Table 2). Participants’ perceived knowledge was associated with their factual knowledge ($F(1, 352) = 29.40$; $p < 0.01$); more factual knowledge was associated with greater perceived knowledge.

Behavioral strategies

Of the six behavioral strategies, the strategy most frequently endorsed as “very hard” was “not traveling themselves to a place where the mosquitos have Zika” (31%) and the one that women least frequently endorsed as “very hard” was “wearing long pants and sleeves” (18%). (Table 3). The mean score was 4.9 (SD = 3.7; range = 0 to 12). A score of 0 indicates that all items were rated as not at all hard to do and a score of 12 indicates that all items were rated as very hard to do. Fifty-four (16%) of the participants thought that all strategies were not at all hard to do; nine (3%) thought that all of the strategies were very hard to do.

In bivariate models, the following variables were not significantly associated with the degree to which the women thought the behavioral strategies would be hard to do: age, having been previously pregnant, race-ethnicity, and factual knowledge. The following were associated with the degree to which the women reported that the behavioral strategies would be hard to do: having an STI history; having lived/traveled in an area with Zika; believing they knew a lot about Zika; being worried about Zika (Table 4). The following remained in the multivariable model; those who had lived/traveled in an area with Zika, were worried, and who had been diagnosed with a STI, were more likely to report that the behavioral strategies were hard to do (Table 4). The mean and standard deviation of perceptions that the behavioral strategies would be hard to do by group are as follows: lived/traveled to an area with Zika ($M=7.7$, $SD=3.0$) versus not having traveled/lived ($M=3.8$, $SD=3.3$); worried about Zika ($M=5.6$, $SD=3.6$) versus not being worried ($M=2.8$, $SD=2.9$), and STI history ($M=6.5$, $SD=3.8$) versus no STI history ($M=4.4$, $SD=3.5$).

Vaccine attitudes and acceptability

With regards to vaccination, 72% thought the development of a Zika vaccine was very important, 25% thought it was somewhat important, and 3% thought it was not important. A universal vaccine strategy (all women and all men between 14 and 40 years of age) was selected by 38% of women, with an additional 20% supporting a gender-specific universal strategy. The other strategies were endorsed by the following percentage of participants: 22% chose “women and male partners of women who are planning to get pregnant within the next year”, 6% chose “only women who are planning to get pregnant” within the next

year, 6% chose “only women whose male partners have Zika”, 8% chose “No one, I don’t believe in vaccines”. When asked if a safe and effective Zika vaccine were available today, 72% said they would agree to get it, 15% said they would decline, and 14% were not sure.

Age, race-ethnicity, having ever been pregnant and vaccine strategy were not related to vaccine acceptability. In bivariate models, a history of STI, having lived/traveled in an area with Zika, believing they knew a lot about Zika, greater factual knowledge, being worried about Zika, considering it important to develop a Zika vaccine, and finding it hard to do behavioral preventative strategies, were associated with likelihood of accepting the vaccine at $p < .10$. (Table 5). The following remained in the multivariable model; considering it important to develop a Zika vaccine, having lived/traveled in an area with Zika, believing they knew about Zika, and being worried about Zika (Table 5). The differences in vaccine acceptability by these predictors was as follows: considering it important to develop a Zika vaccine (73%) versus not believing it was important (18%), lived/traveled to an area with Zika (89%) versus not having traveled/lived (65%); believing they knew a lot about Zika (85%) versus not believing they knew a lot (66%); and being worried about Zika (78%) versus those who were not worried about Zika (55%).

DISCUSSION

WHO continues to view Zika as a public health issue that needs a long-term programmatic approach.²³ In order to modulate the course of Zika and potentially eradicate it, the development of an effective vaccine remains one of the best options.^{17,18,24} However, until a vaccine is developed and available, other preventative strategies will need to be used.

A necessary, although not sufficient, factor to foster preventive behaviors and vaccine uptake is adequate knowledge about one’s susceptibility to the disease and the severity of its consequences. Our results are consistent with those of pregnant women in Greece, in that 11%–13% did not understand mosquito transmission.²⁰ There is even a greater lack of understanding of sexual transmission and that it is unknown how long their male partner can transmit the virus.^{20,21} Other studies have suggested that health care providers may also be insufficiently informed.²⁵ The experience with human papillomavirus vaccine uptake in the U.S. has demonstrated the importance of health care provider support for vaccination in order to foster uptake.²⁶ Thus, addressing knowledge gaps among patients and providers will be crucial to foster Zika vaccine uptake. One study found that the most frequent source of information about Zika came from television or radio; it will be important to determine the best methods for communicating with the public.²⁰

It is well known that factors, such as self-efficacy, are necessary to engage in preventive health behaviors.^{27, 28} For each of the preventive strategies assessed, half or more of the women reported that it would be somewhat hard or very hard to do. Women who viewed themselves as vulnerable (being worried, having lived/traveled in a Zika area, and having a history of an STI) were more likely to view the behavioral strategies as hard to do. It is possible that the sense of vulnerability made them more cautious in assessing their ability to perform the strategies. Other studies have shown that few people engage in behaviors to prevent mosquito bites (16% of pregnant women used clothes and 53% used repellent).²⁰

These numbers may be greater during a Zika epidemic or under threat from another mosquito-borne infection.

Our sample of pregnant women in the U.S. supported Zika vaccine development. The most commonly endorsed strategy by these participants was a universal strategy for both men and women of child-bearing age. Given that perceived severity of an infection is typically critical to vaccine uptake; linking the vaccination to prevention of neonatal disease will be important. Although research that examined acceptability of HPV vaccine prior to vaccine availability overestimated the subsequent uptake, many of the barriers in the U.S. have been structural and systemic given the U.S. reliance on school mandates.²⁹ In contrast, HPV vaccine uptake has been much higher in Australia, which uses school-based immunization.^{30,31} Thus, the imperfect relationship between acceptability and uptake will vary for each specific vaccine and its context. However, the results of this study suggest that pregnant women are interested in a Zika vaccine and find a Zika vaccine personally acceptable.

The findings for vaccine acceptability differed from those for behavioral strategies in that women who perceived themselves as vulnerable (traveling/living in an area with Zika, being worried) reported being likely to get a vaccine. It appears that women with similar characteristics both feel that the behavioral strategies would be hard to do and that they would accept a vaccine. A concern could be raised about risk compensation, i.e., that vaccination could lead to a reduction in other preventive strategies, which in turn might reduce the impact of vaccination.^{32, 33} This concern has been mentioned in relation to other vaccines such as the HPV vaccine (e.g. increased risky sexual behavior or lack of pap smear screening following the HPV vaccine another reference), a Lyme disease vaccine, and HIV vaccination.^{34,35} However, there is no current scientific evidence to support this concern.

Limitations of the study were primarily related to the convenience sample of women living in relatively low risk areas. In addition, we focused on the severity of the illness to adults, not to neonates. However, these limitations were balanced against a large sample of pregnant women from 43 states and Puerto Rico, and the timely assessment of these women's knowledge, attitudes, and willingness to engage in behaviors related to Zika prevention. Future research should specifically target women from high-risk areas and should also aim to compare the attitudes of pregnant women with and without Zika.

CONCLUSIONS

This study has increased our knowledge about pregnant women's understanding of Zika virus and their perceptions about preventative options. We demonstrated a gap between pregnant women's worry about Zika (74%) and their knowledge, both perceived (only 30% thought they knew a lot) and factual (mean of 5.0 out of 8 items). Thus, we need to engage health care providers (who themselves may have knowledge gaps) in playing an active role in ensuring pregnant women are educated about the risks and severity of Zika infection, and the methods for preventing transmission. Pregnant women also will need support to engage in the existing behavioral options to reduce the risk of acquisition. Their concerns about implementing those strategies and the acceptability of a vaccine suggest that vaccine

development should remain a priority. Once a vaccine is available, there will need to be educational campaigns to strengthen the relationship between acceptability and uptake.

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HIGHLIGHTS

- Most (74%) pregnant women expressed concerns about the Zika virus.
- Low perceived knowledge of Zika corresponded to low factual knowledge.
- Developing a Zika vaccine was very important to the majority (72%) of respondents.
- Women (38%) supported a universal strategy that would vaccinate men and women.

Table 1

Sociodemographic Characteristics

Characteristic	N (%) Total N = 362
Relationship with father of the baby	
Married/living with father of the baby	327 (91%)
In a relationship but not living together	17 (5%)
Not in a relationship	16 (4%)
Age group	
18–24	77 (21%)
25–30	140 (39%)
31–35	101 (28%)
35	42 (12%)
Race-ethnicity	
White Non-Hispanic	237 (65%)
African American	27 (7%)
Hispanic	77 (21%)
Other	21 (6%)
Pregnancy History	
Yes	254 (71%)
No	104 (29%)
STI History	
No	277 (77%)
Yes	82 (23%)

Table 2

Percent Correct for Knowledge Items

Knowledge Item	% correct
Mosquito transmission	87%
From mother to her unborn baby	69%
Adults have no/mild symptoms	65%
Shaking hands (correct = no)	65%
From sharing drinks (correct = no)	60%
Through sex	53%
From sneezing on someone (correct = no)	51%
Virus remain in the semen for an unknown period of time	49%

Table 3

Behavioral Strategy (Number and Percent Endorsing)

Behavioral Strategy	Very hard N (%)	Somewhat hard N (%)	Not at all hard N (%)
Not traveling to Zika area	110 (31%)	74 (21%)	176 (49%)
Partner not travel to Zika area	66 (19%)	126 (35%)	164 (46%)
Abstain from sex	100 (28%)	155 (44%)	98 (28%)
Use condoms	87 (25%)	111 (31%)	155 (44%)
Wearing long sleeves and pants	64 (18%)	136 (39%)	151 (43%)
Using mosquito repellent	86 (24%)	91 (25%)	180 (50%)

Table 4

Significant Predictors of Behavioral Strategies

Significant Predictors	Bivariate Analysis		Multivariate Analysis	
	F value	P	F value	P
History of STI (yes vs. no)	F(1,340)= 22.06	**	F(1,337) = 5.80	*
Lived/traveled to a Zika area (yes vs. no)	F(1,343) = 100.53	**	F(1,337) = 52.89	**
Perceived Zika knowledge (a lot vs. less)	F(1,343) =4.24	*	-	
Worried about Zika (yes vs. no)	F(1,343) = 42.94	**	F(1,337)= 18.41	**

*
p < .05**
p < .01

Table 5

Significant Predictors of Vaccine Acceptability

	Bivariate Analysis	Multivariate Analysis
Significant Predictors	OR (95% CI)	AOR (95% CI)
History of STI (yes vs. no)	2.2 (1.2 – 4.2) *	-
Lived/traveled to a Zika area (yes vs. no)	4.4 (2.2 – 8.6) **	2.7 (1.3 – 5.5) **
Perceived Zika knowledge (a lot vs. less)	3.0 (1.7 – 5.4) **	2.9 (1.5 – 6.0) **
Factual Zika knowledge	1.2 (1.1 – 1.3) **	-
Worried about Zika (yes vs. no)	2.8 (1.7 – 4.6) **	1.8 (1.0–3.1) *
Hard to do behavioral strategies	1.1 (1.0 – 1.2) *	-
Considering vaccine important (yes vs. no)	12.4 (2.6 – 58.6) **	10.8(2.1 – 54.3) **

*
p < .05

**
p < .01