Original Research

Zika Virus Concern and Preventative Behaviors During Pregnancy: Analysis of 2017 Georgia Pregnancy Risk Assessment Monitoring System Data

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ABSTRACT

Background: Zika virus infection can cause severe health complications in pregnant women such as microcephaly and other congenital anomalies in the developing fetus but it can be prevented. It is imperative to develop an understanding of concern about Zika virus among pregnant women as this can influence their Zika virus preventative behaviors. The purpose of this study was to gain an understanding of Zika virus concern among women in Georgia with live births in 2017 and to examine the frequency of condom use among those who were sexually active during their most recent pregnancy.

Methods: This cross- sectional study used secondary data collected by Georgia Pregnancy Risk Assessment Monitoring System in 2017. Descriptive analyses were performed on variables of interest. Chi squared tests examined associations between level of concern about Zika virus and socio-demographic variables.

Results: A total of 955 women (age range 18-45) completed the survey. Less than half of the women (n =418, 47.4%) reported they were concerned about Zika virus. Consistent use of condoms was not associated with the level of concern of Zika virus. Among the women, those of Hispanic race/ethnicity were more likely to consistently use condoms during their most recent pregnancy (Adjusted Odds Ratio = 11.37; 95% CI: 3.95-32.81) when compared to Non-Hispanic white women, and this association was found to be statistically significant ($p<0.0001$).

Conclusions: Consistent use of condoms by sexually active women in Georgia during pregnancy appears to vary by race/ethnicity for these women. Findings of this study point to opportunities for engagement on Zika virus awareness and help with refining risk messaging for prevention of Zika virus (or other diseases of global concern) to pregnant women.

Keywords: Zika virus, Georgia Pregnancy Risk Assessment Monitoring System.

INTRODUCTION

Zika virus is a member of the Flaviviridae family that was first discovered in Uganda in 1947 (Dick et al., 1952). It is spread primarily to humans through bites from Aedes sp. mosquitoes (Petersen et al., 2016) that are distributed globally in tropical and subtropical regions (Kraemer et al., 2015). Other non-vector modes of transmission of Zika virus include sexual transmission (Foy et al., 2011), from mother to fetus during pregnancy (Calvet et al., 2016), animal bite (Leung et al., 2015), laboratory exposure (Filipe et al., 1973) and through blood transfusions (Marano et al., 2016). Zika virus RNA has been isolated from semen (Foy et al., 2011), in amniotic fluid of pregnant women (Calvet et al., 2016), blood (Musso et al., 2014) and in urine and saliva of infected patients (Bonaldo et al., 2016).

The incubation period for Zika virus is unknown but it is estimated to be from 3-14 days (Krow-Lucal et al., 2017). About 20% of the patients experience symptoms (Duffy et al., 2009). Common symptoms include macular or papular rash (90% of patients), fever (65%), arthritis or arthralgia (65%), non-purulent conjunctivitis (55%), myalgia (48%), headache (45%), retro-orbital pain (39%), edema (19%), and vomiting (10%) (Duffy et al., 2009). On February 1, 2016, the World Health Organization (WHO) declared the Zika outbreak as a Public Health Emergency of International Concern (Gulland, 2016; Heymann et al., 2016). This was due to the unprecedented increase in the number of babies born with microcephaly, accounting for about 1912 cases as of April 2016 in Brazil (Jaenisch et al., 2017).

It was hypothesized, and later confirmed, that Zika virus was the cause of microcephaly in babies born to pregnant women infected with the virus (Schuler-Faccini et al., 2016). Current data suggest that Zika virus infection during any trimester of pregnancy might result in Zika-associated birth defects (Shapiro-Mendoza et al., 2017). These severe fetal anomalies include microcephaly, intrauterine growth retardation, and ophthalmologic abnormalities (Rasmussen et al., 2016), (Besnard et al., 2016). The full spectrum of Zika virus associated fetal anomalies is unknown and continues to be documented as research evolves (Mlakar et al., 2016).

To date, there have been no locally transmitted (mosquito to human) cases of Zika virus in Georgia (Nguyen et al., 2018) however travel-related cases of Zika virus have been reported in Georgia since December 2015 (Georgia Department of Public Health (DPH)). In addition, Georgia harbors at least 60 different mosquito species with each having a different larval habitat, several of which are known vectors of Zika virus and other exotic arboviruses, and so the potential for carrying and transmitting infectious diseases, including Zika virus infection, cannot be ruled out (Nguyen et al., 2018). Mosquito surveillance in Georgia has determined that *Ae. Albopictus*, a competent Zika virus vector, is present in every county in Georgia (Womack et al., 1995) and has noted *Ae. Ageypti* to be found in Muscogee county in Georgia (Rustin et al., 2017). Further, there may be a large pool of international travelers in Georgia as the world's busiest airport known as Hartsfield Jackson Airport is in Atlanta, Georgia. It is possible that pregnant women or their partners who are Georgia residents would travel to Zika virus-endemic areas and become infected. In addition, there could be persons from Zika virus-endemic areas that move to Georgia.

Presently, there is no vaccine or treatment other than supportive therapy for persons infected with Zika virus (Plourde & Bloch, 2016). Pregnant women must avoid visiting Zika virus endemic areas due to the risk of brain malformation of the fetus (Singh et al., 2018). They must protect themselves from mosquito bites which can be done by using air conditioning or window and door screens when indoors, using insect repellents and wearing long sleeves and pants when outdoors (Hennessey et al., 2016). Given the potential risks of maternal Zika virus infection and the knowledge that Zika virus is sexually transmitted, pregnant women whose partners have or are at risk for Zika virus infection should consider using condoms or abstaining from sexual intercourse (Oster et al., 2016). However, what Zika virus preventative behaviors pregnant women take depend on their concern for Zika virus, as risk perception can be the driver for health-related behavioral changes (Ferrer & Klein, 2015).

Purpose of Research

Given the severity of Zika virus associated birth defects in newborns and the potential for pregnant women to acquire travel related Zika virus infection in Georgia, it is timely to assess the concern about Zika virus among pregnant women and their Zika virus prevention-associated behaviors. There is limited knowledge of concern about Zika virus and on the behavior of condom use among women in Georgia during their most recent pregnancy in 2016, when the Zika virus epidemic was at its height. Since the study population comprises women in Georgia who already gave live birth in 2017, the purpose of this study was to develop an understanding of concern about Zika virus amongst these women during the global outbreak and to examine condom use among those who were sexually active during their most recent pregnancy.

Research Aims

1. Describe the concern about Zika virus among Georgia women with live birth in 2017.
2. Examine the frequency of condom use among those sexually active women with live birth in 2017 in Georgia and association with Zika virus concern and other socio-demographic factors.

METHODS

A quantitative, descriptive, cross-sectional survey research design was utilized to assess the level of concern about Zika virus among the study population. This study used existing secondary data that was collected through the Pregnancy Risk Assessment Monitoring System (PRAMS), an ongoing, state-level, population-based surveillance system of the Centers for Disease Control and Prevention (CDC) for selected maternal behaviors and experiences that occur before, during, and shortly after pregnancy.

Study population

The sample for this study consisted of women who met the eligibility criteria for GA PRAMS. The eligibility criteria for these women is that they must be a resident of Georgia and must have given birth to a live baby within 2017. Even if these women have had multiple births, only one infant from a multiple birth is randomly selected to be included in the sampling frame.

Study Questionnaire

This study examined GA PRAMS data collected from PRAMS Phase 8 questionnaire for 2017, as these were the most current data available at the time of analysis. The GA PRAMS Phase 8 questionnaire consisted of 91 questions about a variety of topics relating to a mother's attitudes, knowledge, and behaviors before, during, and shortly after pregnancy. It consisted of 3 parts: the first part was core questions common to all States participating with PRAMS, second was standard questions developed by CDC that are made available to Georgia, and the third part included the Zika virus supplement (up to 12 additional questions) which was designed to collect information on Zika virus. This study primarily focused on the questions from the Zika virus supplement related to Zika virus concern and condom use behavior.

Data collection

Eligible women in Georgia were sent a GA PRAMS questionnaire 2-6 months post-delivery, along with an introductory letter, a brochure about GA PRAMS, a calendar, a consent letter, and a resource brochure that included telephone numbers for various Georgia programs. If surveys were not returned by mail, attempts were made to conduct the survey over the phone. In addition, as a response incentive, these women received a $10 Walmart gift card as a reward for their participation. The GA PRAMS data were then submitted to the CDC on a yearly basis once the questionnaires are returned. The data were

weighted and stratified so that subpopulations of public health interest, such as mothers of low-birth infants, teen mothers etc., are oversampled to draw stronger conclusions.

Measures

The independent variable chosen was the level of concern of Zika virus of the women during their recent pregnancy: These categories grouped include: 1. "Very worried"/"Somewhat worried": 2. "Not worried": and 3. "Never heard about Zika virus". Additionally, the outcome variable concentrated on frequency of condom use behavior was dichotomized into two categories – Those who used condoms "Every time" / "Never had sex during pregnancy" was combined into one category as these were considered as sound preventative behavior practices to prevent Zika virus infections through sex during pregnancy. Those who used condoms sometimes or never used condoms were grouped together into another category.

A number of demographic variables were considered in the analysis: self-reported race/ethnicity categorized as Non-Hispanic black, Non-Hispanic White, Hispanic and other; maternal age grouped into categories: less than 20 years, 20-29 years and over 30 years of age; maternal education categorized as less than high school, some college, college graduate; income level categorized as <$20,000, $20,000-$36,000, $36000-$48,000 and >$48,000; and marital status as married or not married. Maternal county of residence was classified as Urban or Rural. The classification criteria were based on the urban-rural classification scheme for U.S. counties and county-equivalent entities developed by the National Center for Health Statistics.

Analysis

Since GA PRAMS uses a complex survey design, complex survey procedures to incorporate sampling weights were utilized for analysis of data. Descriptive analyses were performed on independent variables to describe the study population. Next, bivariate analyses using Rao–Scott Chi square tested associations between concern about Zika virus and socio-demographic variables of the study population. Then, another bivariate analysis using Rao–Scott Chi square tested associations between frequency of condom use and socio-demographic variables of the study population. Multivariate analyses were completed with logistic regression using selected independent variables that included maternal race, maternal age, maternal level of education, and marital status was conducted to predict the outcome variable such as the behavior of consistent condom use when having sex during pregnancy. Odds ratios and 95% confidence intervals in both unadjusted and adjusted models were computed. Statistical significance level was set at p-value of 0.05. All analyses were conducted in SAS 9.4.

RESULTS

Shown in Table 1 are demographic characteristics. This study used 2017 data, with a total sample size of 1,362 women, out of which 955 women responded, representing an unweighted response rate of 70%. Of the respondents, the predominant race was Non-Hispanic White, and median age was 29 years. In accordance with this age composition, the most reported marital status was "married." Thirty-five percent of respondents were college educated. The most frequently reported income bracket was over $48,000 per year, and most (84.1%) respondents lived in urban counties.

Presented in Table 2 and Table 3 are the results from the bivariate analyses. As noted in Table 2, significant differences were found in the distribution of the level of concern about Zika virus for all the demographic variables. Overall, less than half of the women in Georgia (47.4%; 95% CI: 42.8-52.0) were reported to be concerned about getting infected with Zika virus.

Less than a quarter, about 11.5%, reported that they never heard of Zika virus. Among these women, most (67%) appeared to be between 20-29 years. As noted in Table 3, there was no significant association (p=0.40) with level of concern about Zika virus and consistent condom use behavior among sexually active women. Overall, among sexually active respondents (N=844) only 8.8% used condoms consistently during their most recent pregnancy. Most of these were Hispanic (54.8%; 95% CI: 38.7-70.9) ($p<0.0001$) and not married (40.4%; 95% CI: 33.9-46.9) ($p<0.03$). Among all women, 9.3% reported that they never had sex during pregnancy. For this study, these participants were excluded from analysis.

In the final adjusted models, as shown in Table 4, even after controlling for all other covariates we did not find a statistically significant association between consistent condom use and level of concern about Zika virus. The study found that among sexually active women, those of Hispanic origin were associated with a greater likelihood of consistently using condoms than respondents of other racial origins (adjusted OR = 11.379; 95% CI: 3.946-32.814) and this association was found to be statistically significant ($p<0.0001$).

Table 1
Sample Characteristics

Variable	N	%
Age	29	25-33*
Education		
Less than High School	16714	13.5
High School Graduate	34932	28.2
Some College	2834372	22..9
College graduate	43726	35.3
Mother's Race/Ethnicity		
Non-Hispanic White	51419	41.7
Non-Hispanic Black	41551	33.7
Hispanic	20263	16.4
Non-Hispanic Other	9943	8.0
Married	124419	
Yes	74624	59.9
No	49795	40.0
Maternal county of residence		
Urban	103896	84.1
Rural	19618	15.8
Income in the 12 months prior to delivery		
<$20,000	30372	29.57
$20,000-$36,000	18402	17.9
$36,000-$48,000	12476	12.1
$48,000 or more	41459	40.3

Note: *IQR-Interquartile range

Table 2
Socio-demographic characteristics of participants by concern of Zika virus

Participant Characteristics	Concerned N (%), 95%CI	Not Concerned N (%), 95%CI	Never heard about Zika virus N (%), (95%CI)	Total N (%)	Chi-square p-value
Total	418 (47.4%)	403 (41.0%)	119 (11.5%)	940 (98.4%)	
Age, years					
<20 s	10 (3.8), (1.2-6.5)	18 (6.4), (2.7-10.1)	14 (21.6), (10.4-32.9)	42 (6.9)	
20-29	158 (42.1), (35.5-48.7)	180 (48.9), (41.6-56.1)	67 (59.7), (46.5-73.0)	405 (46.9)	
30 or older	250 (53.9), (47.3-60.5)	205 (44.6), (37.4-51.7)	38 (18.5), (8.2-28.8)	493 (46.0)	<0.0001*
Education					
Less than High School	62 (14.1), (9.7-18.6)	47 (9.6), (5.4-13.9)	24 (24.9), (13.4-36.4)	133 (13.5)	
High School Grad	102 (22.9), (17.3-28.5)	114 (27.7), (21.2-34.2)	58 (50.5), (36.8-64.1)	274 (28.0)	
Some College	99 (22.4), (16.7-28.0)	116 (24.7), (18.4-30.9)	28 (14.7), (5.3-24.1)	243 (22.5)	<0.0001*
College grad	153 (40.4), (33.9-46.9)	124 (37.8), (30.8-44.8)	7 (9.8), (1.7-17.9)	284 (35.8)	
Mother's race/ethnicity					
NH White	187 (46.1), (39.5-52.7)	133 (39.1), (32.0-46.28)	31 (32.3), (19.6-45.1)	351 (41.6)	
NH Black	125 (23.6), (17.9-29.4)	210 (40.8), (33.6-48.1)	71 (49.5), (36.0-63.1)	406 (33.6)	
Hispanic	85 (22.8), (17.4-28.3)	33 (10.4), (6.2-14.7)	11 (12.1), (4.0-20.3)	129 (16.5)	0.0002*
NH Other	19 (7.2), (3.6-10.9)	23 (9.5), (5.2-13.7)	6 (5.8), (0-12.1)	48 (8.0)	
Married					
Yes	274(67.6) (61.3-73.8)	221(56.8) (49.6-63.9)	44(38.2) (25.1-51.3)	539 (59.7)	0.0003*
No	144(32.3) (26.1-38.6)	182(43.1) (36.0-50.3)	75(61.7) (48.6-74.8)	401 (40.2)	

Note: * A p-value ≤ 0.05 was considered statistically significant

Table 3

Socio-demographic characteristics of participants by consistency of condom use

Socio-demographic Characteristics	Consistent N (%), 95%CI	Not Consistent N (%), 95%CI	Total N (%)	Chi-square p-value
Total	75 (8.7%)	769 (91.2%)	844 (99.9%)	
Age (years)				
<20	4 (10.1), (0.42-19.8)	30 (5.5), (3.1-7.9)	34 (5.9)	
20-29	27 (35.2), (20.1-50.2)	340 (49.5), (44.5-54.6)	367 (48.3)	
30 or older	44 (54.6), (38.8-70.4)	399 (44.8), (39.8-49.8)	443 (45.7)	0.1828
Education				
Less than high school	12 (13.1), (3.36-22.9)	97 (12.3), (9.0-15.5)	109 (12.3)	
High school grad	26 (36.4), (20.8-52.1)	220 (27.8), (23.3-32.4)	246 (28.6)	
Some college	22 (24.1), (10.2-38.0)	201 (23.0), (18.8-27.3)	223 (23.1)	
College grad	14 (26.1), (11.7-40.6)	247 (36.7), (31.8-41.5)	261 (35.8)	0.5716
Mother's race/ethnicity				
NH White	13 (17.3), (5.1-29.7)	324 (46.2), (41.1-51.2)	337 (43.7)	
NH Black	22 (19.0), (6.2-31.8)	322 (34.0), (29.2-38.8)	344 (32.8)	
Hispanic	34 (54.8), (38.7-70.9)	84 (12.9), (9.6-16.1)	118 (16.4)	<0.0001*
NH Other	5 (8.6), (0-17.7)	35 (6.7), (4.1-9.4)	40 (6.9)	
Married				
Yes	32 (44.3), (28.5-60.1)	467 (62.1), (57.2-67.0)	499 (60.5)	
No	43 (55.6), (39.8-71.4)	302 (37.8), (32.9-42.7)	345 (39.4)	0.0335*
Level of concern of Zika virus				
Concerned	25 (33.7), (18.5-48.9)	339 (42.1), (37.1-47.1)	364 (41.4)	
Not concerned	41 (57.6), (41.8-73.4)	341 (46.1), (41.1-51.1)	382 (47.4)	
Never heard of Zika virus	9 (8.6), (0-17.4)	87 (11.7), (8.4-14.9)	96 (11.4)	0.3998

Note: * A p-value ≤ 0.05 was considered statistically significant

Table 4

Socio-demographic characteristics by consistency of condom use

Socio-demographic Characteristics	Consistent use of condoms (N=75)			
	Crude OR (95% CL)	p-value	Adjusted OR (95% CL)	p-value
Age (years)				
<20 years	1.50 (0.45-4.99)	0.5027	1.43 (0.32-6.36)	0.6393
20-29 years	0.58 (0.28-1.18)	0.1376	0.42 (0.183-0.99)	0.047
30 years or older	Reference		Reference	
Education level				
Less than high school	1.50 (0.51-4.36)	0.4567	0.40 (0.10-1.55)	0.188
High school grad	1.83 (0.75-4.44)	0.1802	1.14 (0.36-3.60)	0.814
Some college	1.46 (0.55-3.86)	0.4391	1.81 (0.60-5.43)	0.288
College grad	Reference		Reference	
Maternal race/ethnicity				
NH White	Reference		Reference	
NH Black	1.48 (0.48-4.47)	0.4899	1.02 (0.32-3.16)	0.970
Hispanic	11.24 (4.37-28.83)	<0.001	11.38 (3.94-32.84)	<0.001*
NH Other	3.35 (0.80-13.96)	0.097	3.32 (0.78-14.40)	0.103
Married				
Yes	Reference		Reference	
No	2.06 (1.04-4.03)	0.0365	1.81 (0.75-4.32)	0.181
Level of concern of Zika Virus				
Concerned	1.70 (0.51-5.66)	0.8941	0.90 (0.21-3.70)	0.883
Not concerned	1.09 (0.30-3.84)	0.3874	0.67 (0.17-2.50)	0.547
Never heard of Zika virus	Reference		Reference	

Note: Adjusted Odds Ratio (adjusted for covariates such as maternal race/ethnicity, maternal education, and marital status of moms & ZIKA VIRUS concern level). * A p-value ≤ 0.05 was considered statistically significant.

DISCUSSION

Zika virus infection can cause severe health complications if acquired during pregnancy including microcephaly and other congenital anomalies in the developing fetus, but transmission during pregnancy can be prevented. It is imperative to develop an understanding of concern about Zika virus among pregnant women as this can influence their Zika virus preventative behaviors. The purpose of this study was to gain an understanding of Zika virus concern among women in Georgia with live births in 2017 and to examine the frequency of condom use among those who were sexually active during their most recent pregnancy.

Less than half (47.4%) of women in Georgia were concerned about getting infected with Zika virus and this distribution of concern was significantly different by race/ethnicity, maternal level of education, maternal age, and marital status of these women. This finding however is in contrast to a similar study (D'Angelo et al., 2017) conducted in Puerto Rico using a methodology adapted from PRAMS where a higher percentage (93.4%) of concern about Zika virus was found among women who had live birth in 2016. This could have been attributed to the occurrence of a large outbreak of Zika virus in Puerto Rico from January 2016 to March 2017 that affected more than 3000 pregnant women (Simeone et al., 2016). In addition, cases of Zika virus in Puerto Rico were locally acquired, unlike Georgia where cases of Zika virus were travel-related (Simeone et al., 2016).

Another study conducted by Curry et al. (2018) found results comparable to the study in Puerto Rico where 86.7% of the women in the desiring pregnancy group were concerned that they would become infected with Zika virus compared to few (47.7%) of the women in the group that not desire pregnancy in the next year. This could be because the majority (89.8%) of these women had received information on Zika virus from media and television outlets and the study was conducted during the four weeks immediately following the announcement of local Zika virus transmission (Curry et al., 2018). Another study conducted by Prue et al. (2017) among pregnant women in the U.S. Virgin Islands (USVI) found that more than half of the respondents (54.4%) reported Zika virus as a serious concern although there were varying levels in perceptions of susceptibility among them. It is to be noted that this study was conducted after Zika virus response measures were initiated for these pregnant women which included interventions such as education and outreach measures for prevention of Zika virus (Prue et al., 2017). In addition, the study found that more than half of these pregnant women were aware of health effects of Zika virus (Prue et al., 2017).

In the current study, the finding of a lower percentage of concern about Zika virus among pregnant women in Georgia could be due to many possible reasons. At the time of the study, there had been no local autochthonous transmission of Zika virus in Georgia and so these women may not have felt at risk from getting infected with Zika virus. Furthermore, it is possible that limited knowledge about the potential for sexual transmission impacted their level of concern. In a study in Kentucky, a smaller proportion of survey respondents were aware that the virus could be sexually transmitted (Heitzinger et al., 2018). Also, most cases of Zika virus infection are asymptomatic, and disease is self-limiting which could be another reason for low concern of Zika virus among these women. Some of these women may not have received counselling about Zika virus infection during their prenatal visits as we found that more than 10% of these women never heard about Zika virus.

After reviewing data on behaviors among sexually active women during pregnancy, this study showed a low percentage (10%) of consistent condom users among these women. The reasons for this low percentage are unknown. The knowledge of sexual transmissibility of Zika virus could influence Zika virus preventative behaviors, especially condom use as found in a study conducted among travelers from the United States in 2019 (Nelson et al., 2019).

Unfortunately, this study did not explore the association between knowledge of sexual transmissibility of Zika virus among these women and their condom use behavior, due to limitations in PRAMS survey design. While concern about Zika virus could influence Zika preventative behavior such as condom use, we did not find any association between consistent condom use behavior among these women and their personal concern about Zika virus. This finding was supported by another study in 2018 where condom use among a nationally representative sample of sexually active adults in the United States was not significantly associated with Zika virus concern (Guerra-Reyes et al., 2018).

In contrast, another study by Essen et al. (2019) examined condom use throughout pregnancy during the Zika outbreak in Puerto Rico showed a slightly higher percentage (20.9%) of consistent condom use among sexually active pregnant women. This finding was associated with counseling of these women by healthcare providers, which emphasized the importance of health provider counseling on Zika preventative behaviors (Essen et al., 2019). The most common reason for lack of consistent condom use among these women were because of their thinking that their partner did not have Zika virus and their thinking that condoms were not needed during pregnancy which does suggest that there could be personal barriers to condom use among these pregnant women (Essen et al., 2019). More notable in our study was the behavior of consistent condom use during pregnancy was more common among women of Hispanic race/ethnicity. This is positive and encouraging as this has implications for prevention of all sexually transmitted diseases including Zika virus. In our study we could not explore reasons for the practice of consistent condom as a limitation of the study design. Previous research by Quadagno et al. (1998) examined the influence of ethnicity on sexual behaviors and found that ethnicity influenced joint decision making regarding the timing and

type of sexual activities for Hispanic but not for African American women.

Another study conducted by Soler et al. (2000) found that Black and Hispanic women reported higher levels of consistent condom use (15%-17%) when compared to White women (4%). Another study by Sangi-Haghpeykar et al. (2003) examined condom-related attitudes among Hispanic women and found that Hispanic women with concurrent partners appear to have more favorable attitudes to condoms and use them more consistently. The study also found that the behavior of consistent condom use among these women were associated with their higher perception of risk for both HIV and sexually transmitted diseases (Haghpeykar et al., 2003).

On the contrary, in our study it is noteworthy to highlight that Non-Hispanic White women were found not to be consistently using condoms when having sex during pregnancy. This finding is consistent with results by Copen (2017) in a nationally representative of women and men aged 15-44 in the United States using the National Survey of Family Growth (NSFG); where it was found that prevalence of consistent condom use was the least among Non-Hispanic white women when compared to other race groups. This could be because attitudes regarding contraceptive methods differ among Latina, Black and White young adult women as found in a study conducted by Rocca & Harper (2012). In addition, data from 2017-2019 National Survey of Family Growth that examined current contraceptive use among women aged 15-49 found that the pill was most used among non-Hispanic white women (17.8%) than among Hispanic (7.9%) and non-Hispanic black (8.1%) women in the United States (Daniels & Abma, 2018).

Limitations

Our study has several limitations. First, the data are not representative of all pregnancies in Georgia. The sample only included women who had live births in 2017. Second, since this study used self-reported data collected by participants, there is the potential for this information to be subjected to recall bias that could have caused underreporting of Zika virus preventative behaviors practiced throughout pregnancy. Third, the data for this study is limited as data was collected for one year which is in 2017 and the data are cross-sectional, so they can not imply any causality. Fourth, the study had some missing data which is a limitation of this study. Missing observations are excluded from analyses, and the percentage of missing values is noted when it equals or exceeds 10%. A higher percentage (13%) was noted for a variable such as household income due to non-response. No imputation procedures were used for non-response to this variable. However, this may not limit generalizability of the findings as the study population is intended to be a representative sample of women who are residents in Georgia and the data set is weighted for sample design, non-response, and non-coverage. In addition, the response rate for the study was 70% which exceeds the CDC's response rate threshold of 55% for inclusion of information in reports, publications, and data made available to the public (Shulman et al., 2018).

CONCLUSIONS

Our findings confirm that the level of concern about Zika virus during pregnancy was low among women in Georgia who gave live birth in 2017. Currently, there is no threat to Zika virus from autochthonous transmission in Georgia. However, there is no guarantee that this will continue in future. The epidemiology of pathogens could evolve, and new pathogens could emerge. SARS-CoV-2 is an example of an emerging new pathogen in the current global pandemic where there is limited data on its health effects on pregnant women. Therefore, our research demonstrates that it is important to understand and engage with pregnant women to understand their concern and behaviors for risk reduction of infectious diseases during pregnancy. This can enable better informed decisions to be made, and more focused and appropriate health protection strategies for pregnant women can be developed. Furthermore, the differences by race/ethnicity for preventative behavior during pregnancy indicate that implementation of programs should focus on addressing cultural barriers that might hinder preventative behaviors such as consistent use of condoms to prevent sexual transmission of Zika virus during pregnancy.

References

Besnard, M., Eyrolle-Guignot, D., Guillemette-Artur, P., Lastere, S., Bost-Bezeaud, F., Marcelis, & Mallet, H. P. (2016). Congenital cerebral malformations and dysfunction in fetuses and newborns following the 2013 to 2014 Zika virus epidemic in French Polynesia. *Euro Surveillance, 21*(13). https://doi:10.2807/1560-7917.ES.2016.21.13.30181

Bonaldo, M. C., Ribeiro, I. P., Lima, N. S., Dos Santos, A. A. C., Menezes, L. S. R., da Cruz, S. O. D.,& Brasil, P. (2016). Isolation of Infective Zika Virus from Urine and Saliva of Patients in Brazil. *PLoS Neglected Tropical Diseases, 10*(6), https://doi.org/10.1371/journal.pntd.0004816

Calvet, G., Aguiar, R. S., Melo, A., Sampaio, S. A., de Filippis, I., Fabri, A., Araujo, E., de Sequeira, P. C., de Mendonça, M., de Oliveira, L., Tschoeke, D. A., Schrago, C. G., Thompson, F. L., Brasil, P., Dos Santos, F. B., Nogueira, R., Tanuri, A., & de Filippis, A. (2016). Detection and sequencing of Zika virus from amniotic fluid of fetuses with microcephaly in Brazil: a case study. *The Lancet. Infectious diseases, 16*(6), 653–660. https://doi.org/10.1016/S1473-3099(16)00095-5

Copen C. E. (2017). Condom Use During Sexual Intercourse Among Women and Men Aged 15-44 in the United States: 2011-2015 National Survey of Family Growth. *National Health Statistics Reports,* (105), 1–18. 62-6

Curry, C. L., Tse, C., Billero, V., Hellerstein, L., Messore, M., & Fein, L. (2018). Knowledge and perceptions of Zika virus among reproductive-aged women after public announcement of local mosquito-borne transmission. *The Journal of Obstetrics and Gynaecology Research, 44*(3), 503–508. https://doi.org/10.1111/jog.13533

D'Angelo, D. V., Salvesen von Essen, B., Lamias, M. J., Shulman, H., Hernandez-Virella, W. I., Taraporewalla, A. J., Vargas, M. I., Harrison, L., Ellington, S. R., Soto, L., Williams, T.,

Rodriguez, A., Shapiro-Mendoza, C. K., Rivera, B., Cox, S., Pazol, K., Rice, M. E., Dee, D. L., Romero, L., Lathrop, E., & Warner, L. (2017). Measures Taken to Prevent Zika Virus Infection During Pregnancy - Puerto Rico, 2016. *MMWR. Morbidity and Mortality Weekly Report*, *66*(22), 574–578. https://doi.org/10.15585/mmwr.mm6622a2

Dick, G. W. A., Kitchen, S. F., & Haddow, A. J. (1952). Communications: Zika virus. I. Isolations and serological specificity. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 46*(5), 509-520. doi:10.1016/0035-9203(52)90042-4

Georgia Department of Public Health (DPH), (2017, December 4). *Zika* https://dph.georgia.gov/zika

Duffy, M. R., Chen, T. H., Hancock, W. T., Powers, A. M., Kool, J. L., Lanciotti, R. S., & Hayes, E. B. (2009). Zika virus outbreak on Yap Island, Federated States of Micronesia. *New England Journal of Medicine, 360*(24), 2536-2543. doi:10.1056/NEJMoa0805715

Essen, B. S. von, Kortsmit, K., Warner, L., D'Angelo, D. V., Shulman, H. B., Virella, W. H., Taraporewalla, A., Harrison, L., Ellington, S., Shapiro-Mendoza, C., Barfield, W., Smith, R. A., Jamieson, D. J., Cox, S., Pazol, K., Díaz, P. G., Herrera, B. R., & Bernal, M. V. (2019). Preventing sexual transmission of Zika virus infection during pregnancy, Puerto Rico, USA, 2016. *Emerging Infectious Diseases, 25*(11), 2115–2119

Ferrer, R., & Klein, W. M. (2015). Risk perceptions and health behavior. *Current Opinion in Psychology, 5*, 85-89. doi:10.1016/j.copsyc.2015.03.012

Filipe, A. R., Martins C. M., & Rocha H. (1973). Laboratory infection with Zika virus after vaccination against yellow fever. *Arch Gesamte Virusforsch, 43*(4), 315-319. doi:10.1007/bf01556147

Foy, B. D., Kobylinski, K. C., Chilson Foy J. L., Blitvich, B. J., Travassos da Rosa A., Haddow A. D., & Tesh R. B. (2011). Probable non-vector-borne transmission of Zika virus, Colorado, USA. *Emerging Infectious Diseases, 17*(5), 880-882. doi:10.3201/eid1705.101939

Guerra-Reyes, L., Fu, T. J., Williams, D., Herbenick, D., Dodge, B., Reece, M., & Fortenberry, J. D. (2018). Knowledge of Zika and perception of risk among sexually-active adults in the United States of America: results from a nationally representative sample. *Pan American Journal of Public Health, 42*, 43. https://doi:10.26633/RPSP.2018.43

Hennessey, M., Fischer, M., & Staples, J. E. (2016). Zika Virus Spreads to New Areas - Region of the Americas, May 2015-January 2016. *MMWR. Morbidity and Mortality Weekly Report, 65*(3), 55-58. doi:10.15585/mmwr.mm6503e1

Heitzinger K, Thoroughman DA, Porter KA. Knowledge, attitudes, and practices of women of childbearing age testing negative for Zika virus in Kentucky, 2016. *Preventive Medicine Reports. 2018*;10:20-23. Published 2018 Feb 6. doi:10.1016/j.pmedr.2018.01.002

Heymann, D. L., Hodgson, A., Sall, A. A., Freedman, D. O., Staples, J. E., Althabe, F., Baruah, K., Mahmud, G., Kandun, N., Vasconcelos, P. F., Bino, S., & Menon, K. U. (2016). Zika virus and microcephaly: why is this situation a PHEIC? *Lancet (London, England), 387*(10020), 719–721. https://doi.org/10.1016/S0140-6736(16)00320-2

Jaenisch, T., Rosenberger, K. D., Brito, C., Brady, O., Brasil, P., & Marques, E. T. (2017). Risk of microcephaly after Zika virus infection in Brazil, 2015 to 2016. *Bulletin of the World Health Organization, 95*(3), 191-198. http://dx.doi.org/10.2471/BLT.16.178608

Kraemer, M. U., Sinka, M. E., Duda, K. A., Mylne, A., Shearer, F. M., Brady, O. J., & Hay, S. I. (2015). The global compendium of Aedes aegypti and Ae. albopictus occurrence. *Scientific Data, 2*, 150035. doi:10.1038/sdata.2015.35

Krow-Lucal ER, Biggerstaff BJ, Staples JE. Estimated Incubation Period for Zika Virus Disease. *Emerging Infectious Diseases. 2017 May;23*(5):841-845. doi: 10.3201/eid2305.161715.

Lanciotti, R. S., Kosoy, O. L., Laven, J. J., Velez, J. O., Lambert, A. J., Johnson, A. J., & Duffy, M. R. (2008). Genetic and serologic properties of Zika virus associated with an epidemic, Yap State, Micronesia, 2007. *Emerging Infectious Diseases, 14*(8), 1232-1239. doi:10.3201/eid1408.080287

Leung, G. H., Baird, R. W., Druce, J., & Anstey N. M. (2015). Zika Virus Infection in Australia Following a Monkey Bite in Indonesia. *The Southeast Asian Journal of Tropical Medicine and Public Health, 46*(3), 460-464. https://www.ncbi.nlm.nih.gov/pubmed/26521519

Macnamara, F. N. (1954). Zika virus: a report on three cases of human infection during an epidemic of jaundice in Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 48*(2), 139-145. doi:10.1016/0035-9203(54)90006-1

Marano, G., Pupella, S., Vaglio, S., Liumbruno, G. M., & Grazzini, G. (2016). Zika virus and the never-ending story of emerging pathogens and transfusion medicine. *Blood transfusion = Trasfusione del sangue, 14*(2), 95–100. https://doi.org/10.2450/2015.0066-15

Mlakar, J., Korva, M., Tul, N., Popović, M., Poljšak-Prijatelj, M., Mraz, J., Kolenc, M., Resman Rus, K., Vesnaver Vipotnik, T., Fabjan Vodušek, V., Vizjak, A., Pižem, J., Petrovec, M., & Avšič Županc, T. (2016). Zika Virus Associated with Microcephaly. *The New England Journal of Medicine, 374*(10), 951–958. https://doi.org/10.1056/NEJMoa1600651

Moore, E., Rodriguez, X., Fernandez, D., Griffin, I., Fermin, M. E., Cap, N., & Zhang, G. (2019). Zika Testing Behaviors and Risk Perceptions Among Pregnant Women in Miami-Dade County, One Year After Local Transmission. *Maternal and Child Health Journal, 23*(8), 1140-1145. doi:10.1007/s10995-019-02756-x

Musso, D., Nhan, T., Robin, E., Roche, C., Bierlaire, D., Zisou, K.,& Broult, J. (2014). Potential for Zika virus transmission through blood transfusion demonstrated during an outbreak in French Polynesia, November 2013 to February 2014. *Euro Surveillance, 19*(14). https://doi.org/10.2807/1560-7917.ES2014.19.14.20761

Nelson, E. J., Luetke, M. C., McKinney, C., & Omodior, O. (2019).Knowledge of the Sexual Transmission of Zika Virus and Preventive Practices Against ZikaVirus Among U.S. Travelers. *Journal of Community Health, 44*(2), 377-386. https://doi.org/10.1007/s10900-018-0594-x

Nguyen, T. V., Kelly, R., Stuck, S., & Rustin, R. C. (2018). Georgia's Collaborative Approach to Expanding Mosquito Surveillance in Response to Zika Virus: Year Two. *U.S. Army Medical Department Journal* (1-18), 14-21. https://www.ncbi.nlm.nih.gov/pubmed/30165717

Oster, A. M., Russell, K., Stryker, J. E., Friedman, A., Kachur, R. E., Petersen, E. E., & Brooks, J. T. (2016). Update: Interim Guidance for Prevention of Sexual Transmission of Zika Virus--United States, 2016. *MMWR. Morbidity and Mortality Weekly Report, 65*(12), 323-325. http://dx.doi.org/10.15585/mmwr.mm6505e1

Petersen, L. R., Jamieson, D. J., & Honein, M. A. (2016). Zika Virus. *The New England Journal of Medicine, 375*(3), 294–295. https://doi.org/10.1056/NEJMc1606769

Plourde, A. R., & Bloch, E. M. (2016). A Literature Review of Zika Virus. *Emerging Infectious Diseases*, 22(7), 1185–1192. https://doi.org/10.3201/eid2207.151990

Prue, C. E., Roth Jr., J. N., Garcia-Williams, A., Yoos, A., Camperlengo, L., DeWilde, L., Lamtahri, M., Prosper, A., Harrison, C., Witbart, L., Guendel, I., Wiegand, D. M., Lamens, N. R., Hillman, B. anna, Davis, M. S., Ellis, E. M., Roth, J. N., Jr, & Hillman, B. (2017). Awareness, Beliefs, and

Actions Concerning Zika Virus Among Pregnant Women and Community Members - U.S. Virgin Islands, November-December 2016. *MMWR: Morbidity & Mortality Weekly Report, 66*(34), 909–913. https://doi.org/10.15585/mmwr.mm6634a4

Quadagno D, Sly DF, Harrison DF, Eberstein IW, Soler HR. Ethnic differences in sexual decisions and sexual behavior. *Archives of Sexual Behavior. 1998 Feb;27*(1):57-75. doi: 10.1023/a:1018657825068.

Rasmussen, S. A., Jamieson, D. J., Honein, M. A., & Petersen, L. R. (2016). Zika Virus and Birth Defects--Reviewing the Evidence for Causality. *New England Journal of Medicine, 374*(20), 1981-1987. doi:10.1056/NEJMsr1604338

Rosenstock, I. M. (1982). The health belief model and nutrition education. *Journal of the Canadian Dietetic Association, 43*(3), 184-192.

Rocca, C. H., & Harper, C. C. (2012). Do Racial and Ethnic Differences in Contraceptive Attitudes and Knowledge Explain Disparities In Method Use? *Perspectives on Sexual & Reproductive Health, 44*(3), 150–158. https://doi.org/10.1363/4415012

Rustin, R. C., Martin, D., Sevilimedu, V., Pandeya, S., Rochani, H., & Kelly, R. (2017). Georgia's collaborative approach to expanding mosquito surveillance in response to Zika virus: a case study. *U.S. Army Medical Department Journal* (1-17), 23-33.

Salvesen von Essen, B., Kortsmit, K., Warner, L., D'Angelo, D. V., Shulman, H. B., Virella, W. H.,& Bernal, M. V. (2019). Preventing Sexual Transmission of Zika Virus Infection during Pregnancy, Puerto Rico, USA, 20161. *Emerging Infectious Diseases, 25*(11), 2115-2119. https://dx.doi.org/10.3201/eid2511.190915

Sangi-Haghpeykar, H., Poindexter, A. N., Young, A., Levesque, J. E., & Horth, F. (2003). Extra-relational sex among Hispanic women and their condom-related behaviours and attitudes. *AIDS Care, 15*(4), 505. https://doi.org/10.1080/0954012031000134746

Schuler-Faccini, L., Ribeiro, E. M., Feitosa, I. M., Horovitz, D. D., Cavalcanti, D. P.,& Pessoa, A. Brazilian Medical Genetics Society-Zika Embryopathy Task, F. (2016). Possible Association Between Zika Virus Infection and Microcephaly - Brazil, 2015. *MMWR: Morbidity & Mortality Weekly Report, 65*(3), 59-62. http://dx.doi.org/10.15585/mmwr.mm6503e2

Shapiro-Mendoza CK, Rice ME, Galang RR, et al. Pregnancy Outcomes After Maternal Zika Virus Infection During Pregnancy — U.S. Territories, January 1, 2016–April 25, 2017. *MMWR: Morbidity & Mortality Weekly Report 2017; 66*:615-621. DOI: http://dx.doi.org/10.15585/mmwr.mm6623e1

Shulman, H. B., D'Angelo, D. V., Harrison, L., Smith, R. A., & Warner, L. (2018). The Pregnancy Risk Assessment Monitoring System (PRAMS): Overview of Design and Methodology. *American Journal of Public Health, 108*(10), 1305–1313. https://doi.org/10.2105/AJPH.2018.304563

Simeone, R. M., Shapiro-Mendoza, C. K., Meaney-Delman, D., Petersen, E. E., Galang, R. R., Oduyebo, T., Rivera-Garcia, B., Valencia-Prado, M., Newsome, K. B., Pérez-Padilla, J., Williams, T. R., Biggerstaff, M., Jamieson, D. J., Honein, M. A., & Zika and Pregnancy Working Group (2016). Possible Zika Virus Infection Among Pregnant Women - United States and Territories, May 2016. *MMWR. Morbidity and Mortality Weekly Report, 65*(20), 514–519. https://doi.org/10.15585/mmwr.mm6520e1

Singh, R. K., Dhama, K., Khandia, R., Munjal, A., Karthik, K., Tiwari, R.,& Bueno-Marí, R. (2018). Prevention and Control Strategies to Counter Zika Virus, a Special Focus on Intervention Approaches against Vector Mosquitoes-Current Updates. *Frontiers in Microbiology, 9*, 87-87. doi:10.3389/fmicb.2018.00087

Soler, H., Quadagno, D., Sly, D. F., Riehman, K. S., Eberstein, I. W., & Harrison, D. F. (2000). Relationship dynamics, ethnicity and condom use among low-income women. *Family Planning Perspectives, 32*(2), 82–101.

Womack, M. L., Thuma, T. S., & Evans, B. R. (1995). Distribution of Aedes albopictus in Georgia, USA. *Journal of the American Mosquito Control Association, 11*(2 Pt 1), 237. https://www.ncbi.nlm.nih.gov/pubmed/7595452