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

Priya Nair

ABSTRACT

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

By

PRIYA NAIR

DECEMBER 3, 2019

INTRODUCTION: Zika virus infection can cause severe health complications in pregnant women that include microcephaly and other congenital anomalies in the developing fetus. There is evidence that Zika virus can be spread through unprotected sex. Prevention is the only defense to protect pregnant women and their infants from Zika virus. What preventative behaviors these pregnant women take is most likely influenced by their concern about Zika virus. Little is known about the level of concern about Zika virus, and about preventative behaviors such as condom use, among pregnant women in Georgia.

AIM: The purpose of this study is to develop an understanding of concern about Zika virus among women in Georgia with live birth in 2017 and to examine the frequency of condom use among sexually active respondents 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. A multivariable logistic regression model that controlled for age, education, race/ethnicity, marital status was used to examine the behavior of consistent condom use when having sex during pregnancy and Zika virus concern.

RESULTS: A total of 955 respondents (age range 18-45) completed the survey. Less than half of the women (n =418,47.4%) were concerned about Zika virus. The distribution of those that were concerned was different by race/ethnicity, level of education, age and marital status of women in Georgia with live birth in 2017. Less than 10% of Georgian women with recent live birth in 2017 consistently used condoms when having sex during pregnancy. Consistent use of condoms was mot 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 ($p<0.0001$).

CONCLUSION: Consistent use of condoms by sexually active women in Georgia during pregnancy appears to vary by race/ethnicity and relationship status and level of education of 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 to pregnant women.

Key words: Zika virus ZIKV, Georgia Pregnancy Risk Assessment Monitoring System GA PRAMS

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by

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Author's Statement Page

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I.INTRODUCTION

1.1 ***Background***

Zika virus (ZIKV) is a member of the *Flaviviridae f*amily that was first discovered in Uganda in 1947 (Dick, Kitchen, & Haddow, 1952). It is spread primarily to humans through bites from *Aedes* species mosquitoes (Petersen, Jamieson, Powers, & Honein, 2016) that are distributed globally in tropical and subtropical regions (Kraemer et al., 2015). Other non-vector modes of transmission of ZIKV include sexual transmission (Foy et al., 2011), from mother to fetus during pregnancy (Calvet et al., 2016), animal bite (Leung, Baird, Druce, & Anstey, 2015), laboratory exposure (Filipe, Martins, & Rocha, 1973) and through blood transfusions (Marano, Pupella, Vaglio, Liumbruno, & Grazzini, 2016). ZIKV 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).

ZIKV was first recognized as causing a human illness when it was confirmed as an infection in three patients in Nigeria in 1953 (Macnamara, 1954). The incubation period for ZIKV is unknown but it is estimated to be from 3-14 days (Krow-Lucal, Biggerstaff, & Staples, 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%), nonpurulent conjunctivitis (55%), myalgia (48%), headache (45%), retro-orbital pain (39%), edema (19%), and vomiting (10%) (Duffy et al., 2009). The rash experienced by most patients is maculopapular and pruritic (Simpson, 1964) and the fever is described as short term and low grade (Brasil et al., 2016).

In 2007, ZIKV emerged outside Asia and Africa, with its first outbreak reported on Yap Island in the Federated States of Micronesia that infected more than 73% of the population (Duffy et al., 2009). Thereafter, there have been outbreaks that occurred in French Polynesia (Baronti et al., 2014), Cook Islands (Roth et al., 2014), Easter Island (Tognarelli et al., 2016), New Caledonia (Dupont-Rouzeyrol et al., 2015), Brazil (Zanluca et al., 2015) and, most recently, in the Americas (Fauci & Morens, 2016). As of July 2019, ZIKV infections have already spread locally in 87 countries, and travel alerts have been issued for the countries where the virus is present (WHO, 2019). Currently, there is no local transmission of ZIKV in the continental United States but previous local transmission of ZIKV was reported in Florida and Texas in 2016-2017 (Porse et al., 2018).

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 ZIKV was the cause of microcephaly in babies born to pregnant women infected with the virus (Schuler-Faccini et al., 2016).

Current data suggest that ZIKV 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, Jamieson, Honein, & Petersen, 2016), (Besnard et al., 2016). The full spectrum of ZIKV associated fetal anomalies is unknown and future research needs to be done (Mlakar et al., 2016).

In adults, ZIKV infection has been associated with Guillain-Barré Syndrome (GBS) (Cao-Lormeau et al., 2016). Other neurological abnormalities with ZIKV infection include meningoencephalitis, acute myelitis, facial paralysis, paresthesia, photophobia, and hearing difficulties (Araujo, Silva, & Araujo, 2016).

To date, there have been no locally transmitted (mosquito to human) cases of ZIKV in Georgia (Nguyen, Kelly, Stuck, & Rustin, 2018) however travel-related cases of ZIKV have been reported in Georgia since December 2015 (Georgia Department of Public Health DPH, 2017). In addition, Georgia harbors at least 60 different mosquito species with each having a different larval habitat, several of which are known vectors of ZIKV and other exotic arboviruses, and so the potential for carrying and transmitting infectious diseases, including ZIKV infection, cannot be ruled out (Nguyen et al., 2018). Mosquito surveillance in Georgia has determined that *Ae. Albopictus*, a competent ZIKV vector, is present in every county in Georgia (Womack, Thuma, & Evans, 1995) and has noted *Ae. Ageypti* to be found in Muscogee county in Georgia (Rustin et al., 2017). Further, there is the accessibility to international travelers, 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 ZIKV-endemic areas and become infected. In addition, there could be persons from ZIKV-endemic areas that move to Georgia.

Presently, there is no vaccine or treatment other than supportive for persons infected with ZIKV (Plourde & Bloch, 2016). Pregnant women must avoid visiting ZIKV 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, use insect repellents and wearing long sleeves and pants when outdoors (Hennessey, Fischer, & Staples, 2016). Given the potential risks of maternal ZIKV infection and that ZIKV is sexually transmitted, pregnant women whose partners have or are at risk for ZIKV infection should consider using condoms or abstaining from sexual intercourse (Oster et al., 2016).

In April 2016, the Georgia Department of Public Health (GDPH) developed campaign materials/ factsheets to spread awareness to the public on ZIKV transmission, which also informed pregnant women to use condoms with sexual partners if they had potentially been exposed to ZIKV (Georgia Department of Public Health DPH, 2017). However, what ZIKV preventative behaviors pregnant women take depend on their perceived susceptibility to ZIKV as risk perception can be the driver for health-related behavioral changes (Ferrer & Klein, 2015).

1.2 ***Purpose of Research***

Given the severity of ZIKV associated birth defects in newborns and the potential for pregnant women to acquire travel related ZIKV infection in Georgia, it is timely to assess the concern about ZIKV among pregnant women and their ZIKV prevention-associated behaviors.

There is limited knowledge of concern about ZIKV and on the behavior of condom use among women in Georgia during their most recent pregnancy in 2016, when the ZIKV epidemic was at its height. Since the study population comprises of women in Georgia who already gave live birth in 2017, the purpose of this study is to develop an understanding of concern about ZIKV amongst these women and to examine condom use among those who were sexually active during their most recent pregnancy.

1.3 Research Aims

1.Describe the concern about ZIKV among Georgia women with live birth in 2017.

2. Examine the frequency of condom use among those sexually active Georgian women with live birth in 2017 and association with ZIKV concern and other socio-demographic factors.

2. **REVIEW OF LITERATURE**

2.1 ***Epidemiology of Zika virus***

ZIKV is a mosquito-borne virus, belongs to the *Flaviviridae* family that was first isolated in the Zika forest near Entebbe, Uganda in 1947. The virus was later isolated from a pool of *Aedes africanus* mosquitoes collected in the same forest in 1948 (Dick et al., 1952). Simpson reported the first real human infection while isolating the virus from *Ae.africanus* mosquitoes in Uganda between 1962-1963 (Simpson, 1964). Several mosquito species belonging to the *Aedes* genus have been identified as potential transmission vectors for ZIKV. However, two species, *Ae. aegypti* and *Ae. Albopictus*, have been noted because their distribution is widespread compared to many other species (Grard et al., 2014; Li, Wong, Ng, & Tan, 2012).

Three cases of Zika fever, through virus isolations from children, were identified in Nigeria as reported by Moore in 1968 (D. L. Moore et al., 1975). Since then, additional cases of ZIKV have been reported in humans, with most of these broadly distributed in Africa and Asia. The first notable major outbreak occurred in the Yap Islands of Micronesia in 2007,where a majority (70%) of the population ≥ 3 years old were infected (Duffy et al., 2009). Similarly, another epidemic occurred in French Polynesia from 2013 to 2014, which affected about two-thirds of the people, resulting in approximately 32,000 infected cases (Cao-Lormeau et al., 2016).

Since then, ZIKV spread eastward across the Pacific Ocean to the Americas, culminating in the 2015–2016 ZIKV epidemic. In March 2015, an outbreak of ZIKV was reported for the first time on continental South America in Brazil that affected more than 500,000 persons. Furthermore, 29 other countries in the Americas have reported autochthonous ZIKV transmission, including Puerto Rico and the US Virgin Islands.

As stated in the Zika Epidemiological report prepared by the Pan American Health Organization of the World Health Organization (WHO) in 2016, the Centers for Disease Control and Prevention (CDC) in the United States (U.S.) reported 4,830 travel related Zika cases in 49 states and Washington, D.C. However, confirmed autochthonous vector-borne transmission of ZIKV was reported only in the states of Florida (Florida Department of Public Health, 2017) and Texas (Services, 2019). ZIKV transmission has been found in all countries in the Region of the Americas except mainland Chile, Uruguay, and Canada. Currently, there is no local transmission of ZIKV in the continental United States, but previous local transmission of ZIKV was reported in Florida and Texas in 2016-2017 (Porse et al., 2018).

In Georgia, the first travel-associated case of ZIKV was reported in December 2015. As of December 2017, there were a total of 120 travel-associated cases (Georgia Department of Public Health DPH, 2017).To date, there have been no locally transmitted (mosquito to human) cases of ZIKV in Georgia (Nguyen et al., 2018). As of July 2019, a total of 87 countries and territories have had evidence of autochthonous mosquito-borne transmission of ZIKV, distributed across four of the six WHO Regions (WHO 2019). In 2018, Ethiopia was the only new country added to the list of countries with evidence of autochthonous, mosquito-borne transmission, based on a publication of a 2014 study (Mengesha Tsegaye et al., 2018).

Globally, there is evidence of established *Aedes aegypti* vectors reported in 61 countries and territories in six WHO regions that have not yet documented ZIKV transmission (WHO 2019). Therefore, the potential for risk of ZIKV to continue to spread cannot be ruled out. In addition, all those areas with prior reports of ZIKV transmission have the potential for re-emergence or re-introduction of the virus. Further, Georgia harbors at least 60 different mosquito species with each having a different larval habitat and several of which are known vectors of ZIKV and other exotic arboviruses. Therefore, potential for carrying and transmitting infectious diseases, including ZIKV infection, cannot be ruled out (Nguyen et al., 2018). Mosquito surveillance in Georgia has determined that has noted *Ae. Ageypti* to be found in Muscogee county in Georgia (Rustin et al., 2017) and *Ae. Albopictus*, a ZIKV vector, to be present in every county in Georgia (Womack et al., 1995).

2.2 Modes of transmission

ZIKV is spread primarily to humans through bites from *Aedes* genus mosquitoes (Petersen et al., 2016). However, there is evidence that it can be spread through sexual transmission. In Colorado in 2008, one case of person to person transmission of ZIKV through male to female sexual contact was concluded through circumstantial evidence by serologic testing (Foy et al., 2011). Possible transmission by animal bite was reported in a study conducted by (Leung et al., 2015) that found a traveler to Indonesia was bitten by a monkey and was subsequently diagnosed with ZIKV infection on their return to Australia. In addition, laboratory exposure of ZIKV has been reported (Filipe et al., 1973). Intrauterine transmission is supported by the detection of ZIKV in amniotic fluid of two mothers with symptoms of ZIKV infection during pregnancy (Calvet et al., 2016). ZIKV has been detected in breast milk but transmission by breast-feeding has not been reported (Besnard et al., 2016). Two cases of possible transfusion transmitted ZIKV were also reported in Brazil (Musso et al., 2014).

2.3 Clinical manifestations

ZIKV in humans clinically presents with mild, self-limiting and non-specific symptoms that are like other arbovirus infections. Infection is asymptomatic in 80% of the cases and the incubation period is estimated to range from 3 to 14 days (Krow-Lucal et al., 2017). The most commonly reported symptoms include maculopapular rash, fever, arthralgia, myalgia, fatigue, headache, and conjunctivitis (Duffy et al., 2009). In May 2016, a potential causal relationship between ZIKV infection during pregnancy and microcephaly and other serious brain anomalies was first reported (Rasmussen et al., 2016).

The outbreak in French Polynesia was associated with about 70 cases of severe presentation including Guillain-Barré syndrome (Cao-Lormeau et al., 2016), and other more severe pathological abnormalities have been associated with ZIKV infection, including meningoencephalitis in the Pacific Islands (Carteaux et al., 2016) and myelitis in Guadeloupe (Mecharles et al., 2016). Other neurological abnormalities associated with ZIKV infection include facial paralysis, paresthesia, photophobia, and hearing difficulties (Araujo et al., 2016). Most strikingly, during the outbreak in Brazil, the incidence of microcephaly (Melo et al., 2016) dramatically increased in newborns prompting several agencies to issue advisories to pregnant women and those considering pregnancy. Studies are ongoing on ZIKV as aspects of pathogenesis of ZIKV still remain unclear (Mlakar et al., 2016).

2.4 Diagnosis

Clinical evaluation of symptoms alone is not sufficient for a diagnosis of ZIKV infection because ZIKV has symptoms that overlap with infections of other arboviruses (Plourde & Bloch, 2016), therefore, laboratory testing is required. ZIKV testing should be considered in patients that have a clinically compatible illness who live in or have recently traveled to a ZIKV endemic area or in those who had sex with someone who lives in or recently traveled to those areas (CDC 2018). Molecular amplification (e.g., RT-PCR) on serum samples and serologic testing are two methods employed to diagnose ZIKV infection. ZIKV RNA is likely to be detected in serum from approximately 2 days before to 1 week after illness onset (Paz-Bailey et al., 2018). IgM antibodies directed against ZIKV typically develop during the first week of illness (Lanciotti et al., 2008).

Neutralizing antibodies develop shortly after IgM antibodies and consist primarily of IgG antibodies; these persist for multiple years after flavivirus infections and usually confer long-lived immunity (Griffin et al., 2019). Molecular testing can detect ZIKV during the acute phase of illness (< than 7 days from symptom onset) when compared to serologic testing. Another method for testing is using nucleic acid amplification tests (NAATS), which can provide confirmed evidence of infection and distinguish the specific virus (Shan et al., 2017).Plaque reduction neutralization tests (PRNTs) are quantitative assays that measure virus-specific neutralizing antibody titers for dengue, ZIKV, and other flaviviruses to which the patient might have been exposed (Calisher et al., 1989). For diagnostic testing, CDC uses a PRNT with a 90%

cutoff value titer ≥10 in serum and ≥2 in cerebrospinal fluid (the typical starting dilutions) to define positive specimens.

According to 2019 diagnostic testing recommendations for ZIKV from the CDC, pregnant women with a clinically compatible illness and recent possible exposure to ZIKV should have concurrent diagnostic testing for dengue and ZIKV infection performed by NAAT and IgM antibody testing on a serum specimen and NAAT on a urine specimen to diagnose ZIKV infection. If pregnant women are asymptomatic without ongoing risk for possible ZIKV infection, testing for ZIKV infection is not routinely recommended.

2.5 Prevention and management

Currently there is no curative treatment or vaccine available for ZIKV infection. Treatment is generally supportive and can include rest, fluids, and use of analgesics and antipyretics (da Silva, Oliveira Silva Martins, & Jardim, 2018). Persons infected with ZIKV should be protected from further mosquito exposure during the first few days of illness to reduce the risk for local transmission. Strategies to avoid mosquito bites include using air conditioning or window and door screens when indoors and wearing long sleeves and long pants, using permethrin-treated clothing and gear, and using EPA-registered insect repellents when outdoors (Hennessey et al., 2016). Pregnant women should consider postponing travel to any ZIKV endemic area where ZIKV transmission is ongoing, and if they cannot postpone the travel, they should talk to their health care provider before traveling so they can take adequate precautions to avoid mosquito bites (Singh et al., 2018). Given the potential risks of maternal ZIKV infection, pregnant women whose partners have or are at risk for ZIKV infection should consider using condoms or abstaining from sexual intercourse (Oster et al., 2016).

2.6 Zika virus concern among pregnant women

As ZIKV infection remains a significant public health concern to pregnant women and their unborn babies due to severe health consequences including microcephaly and other ZIKV associated birth defects, it is imperative for pregnant women to use appropriate ZIKV preventative behaviors. Risk perception could be the driver for behavioral changes, particularly for health-related behavior (Ferrer & Klein, 2015). This assumption is based on the Health Belief Model–the concept being that one's personal concern of illness is one of the factors motivating the person to adopt preventative health behaviors for that illness (Rosenstock, 1982). Therefore, the ZIKV preventative actions/behaviors pregnant women take is largely influenced by their concern about getting infection with ZIKV.

Previous research had examined concern of pregnant women to mosquito-borne viruses including ZIKV and their association with regards to preventative behaviors. A study conducted to assess concern of ZIKV in Lower Saxony, Germany, with a special focus on pregnant women found that the highest percentages of concern about ZIKV was among women who were currently pregnant or planning to become pregnant (Obenauer et al., 2018). A study conducted in Malaysia found participants with a higher score for perception of severity of ZIKV were more likely to report greater mosquito control practices after the declaration of a Public Health Emergency of International Concern (PHEIC) (Wong, Alias, Aghamohammadi, Sam, & AbuBakar, 2017).

Similarly, a study that assessed perceptions of the ZIKV among residents in United States prior to domestic transmission of ZIKV found that those who believed themselves to be at risk for ZIKV were more likely to endorse pregnancy delay (Piltch-Loeb, Abramson, & Merdjanoff, 2017). Another study which assessed risk perceptions and testing behaviors concerning ZIKV among Miami-Dade's pregnant women found a significant association ($p \leq 0.0001$) between pregnant women who thought that they should be tested and those who perceived ZIKV to be a medium to big problem in their community (E. Moore et al., 2019). In addition, a study conducted on pregnant women indicated that the perception of susceptibility to ZIKV is an important predictor of improving prevention practices around ZIKV transmission (Siramaneerat, 2018).

3. METHODS AND PROCEDURES

3.1 Sample

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. Georgia has collected PRAMS data since 1993. Each month, approximately 100-200 women are selected from recent birth certificates using stratified random sampling (Georgia Department of Public Health, 2017). The eligibility criteria for these women is that they must be a resident in 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.

3.2 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 comprised 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 ZIKV supplement (up to 12 additional questions) which is designed to collect information on ZIKV. This study primarily focused on the questions from the ZIKV supplement related to ZIKV concern and condom use behavior.

3.3 Method of Data collection

Eligible women 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 are submitted to the CDC on a yearly basis once all the surveys are returned. The CDC does require a minimum overall response rate of 60% for data collected after 2011. The data are 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.

3.4 Measures

Concern about ZIKV among participants was measured using the question “During your most recent pregnancy, how worried were you about getting infected with Zika virus?” The response choices were: “Very worried”, “Somewhat worried”, “Not at all worried”, “I had never heard about Zika virus” during my recent most pregnancy. This variable was coded as “Concerned” if the response was “Very Worried,” or “Somewhat worried” and if the response was “Not at all worried “, then the variable was coded as “Not Concerned”. The response was coded as “Never heard of ZIKV” if the response was “I had never heard about ZIKV during my recent most pregnancy”.

Sociodemographic data on maternal characteristics included in the analysis were:

1. Maternal race/ethnicity classified into the following categories: Non-Hispanic White; Non-Hispanic Black; Other; and Hispanic.
2. Maternal age categorized as less than 20 years of age, 20–29 years of age and 30 years of age or older.
3. Maternal education categorized as “less than High School”, “High school grad”, “Some college” and “College grad”.
4. Marital status categorized as “Married” or “Not married”.
5. Maternal county of residence was categorized as “Urban” or “Rural”. This criteria for classifying the county in this manner was based on the urban-rural classification scheme for U.S. counties and county-equivalent entities developed by the National Center for Health Statistics. The scheme groups U.S. counties and county-equivalent entities into five urbanization levels (three metropolitan and two nonmetropolitan), on a continuum

ranging from most urban to most rural. Under the Metropolitan category- this comprised of 3 levels that include 1> Large metro- Counties in Metropolitan Statistical Areas (MSAs) of 1 million or more population, 2>Medium metro—Counties in MSAs of populations of 250,000 to 999,999,3> Small metro—Counties in MSAs of populations less than 250,000.

Then under the Nonmetropolitan category-this comprised of 2 levels that include 1> Micropolitan-Counties in MSAs of populations of 25000 to 49,999,2>Noncore- Non-metropolitan counties that did not qualify as Micropolitan.

6. The outcome variable, condom use frequency to prevent sexual transmission of ZIKV by participants was measured with the question "During your most recent pregnancy, how often did you use condoms when you had sex with your husband or any male partner?" with response choices: 'Every time', 'Sometimes', 'Never' and 'I didn't have sex during my pregnancy'. This study did not analyze data for those that responded, "I didn't have sex during pregnancy". The variable for condom use frequency was coded as "Consistent" if the response was "Every time and was coded as "Not Consistent" if the response was "Sometimes" or "Never".

3.5 Data Analysis

Since GA PRAMS uses a complex survey design, complex survey procedures using SAS 9.4 to incorporate sampling weights was 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 ZIKV 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 was 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.

4. RESULTS

4.1: Demographic characteristics of sample

This study used 2017 data, with a total sample size of 1362 women, out of which 955 women responded, representing an unweighted response rate of 70%. This response rate exceeded the CDC's average response rate of 60%. As presented in Table 1, 42% of the Georgian women were Non-Hispanic White, 35% were college educated, and the median age of study participants was 29 years. In addition, 59.9% were married, 40.1% had an income level of > than $48,000, and 84.1% of these women lived in urban counties.

4.2 Associations of levels of concern of Zika virus and covariates

The weighted bivariate associations between ZIKV levels of concern and the covariates are shown in Table 2a. Significant differences were found in the distribution of the level of concern about ZIKV 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 ZIKV. Among those women who were concerned about getting infected with ZIKV, most were 30 years of age or older (53.9%; 95% CI: 47.3-60.5), Non-Hispanic White (46%; 95% CI: 49-52), College educated (40.4%; 95% CI: 33.9-46.9), and were married (67.6; 95% CI: 61.3-73.8). Less than a quarter, about 11.5%, reported that they never heard of ZIKV. Among these women, there were noted differences in age distribution. About 67% of those that had never heard about ZIKV appeared to be between 20-29 years.

4.3 Associations of frequency of condom use and covariates

The weighted bivariate associations between the frequency of condom use during pregnancy and covariates are presented in Table 2b. Among all women, 9.3% reported that they never had sex during pregnancy. For the purpose of this study, these participants were excluded from analysis. 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) ($p<0.03$). The association with level of concern about ZIKV and consistent condom use behavior among sexually active respondents was not significant ($p=0.40$).

4.4 Unadjusted and adjusted odds ratios for the associations between consistent condom use behavior and covariates

The unadjusted and adjusted odds ratios, and 95% confidence intervals for the association between those who consistently use condoms (N=75) when having sex during pregnancy, and covariates including demographic variables including the variable for level of concern about ZIKV are shown in Table 3.

In the unadjusted model, respondents who are Hispanic were found to be more likely to consistently use condoms when having sex during pregnancy than respondents of other racial/ethnic groups (Odds Ratio [OR] = 11.2; 95% CI: 4.4-28.8); this association was statistically significant ($p<0.0001$). Further, among sexually active respondents, those who were not married (OR = 2.055; 95%CI: 1.046-4.036) were more likely to consistently use condoms than those who were married. It appears that among Georgian women who were sexually active, their concern about ZIKV was not associated with consistent condom use during pregnancy ($p=0.39$). In the final adjusted models, as shown in Table 3, even after controlling for all other covariates we did not find a statistically significant association between consistent condom use and level of concern about ZIKV.

It was interesting to find that among sexually active respondents, 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 ($p<0.0001$).

There was no significant association between age categories of sexually active respondents and their behavior of condom use in the unadjusted model. However, in the adjusted model, it was found that among the sexually active respondents, those respondents who had an age range from 20-29 years were less likely (adjusted Odds Ratio = 0.42; 95%CI: 0.83-0.99) to use condoms consistently when compared to those sexually active respondents who were 30 years or older; this association was found to be significant.

Similarly, the unadjusted model did not show any significant difference in the association between the consistent behavior of condom use and level of education of the participants. However, in the adjusted model, among sexually active respondents, it was found that those who had some College education were more likely to use condoms consistently (Adjusted Odds ratio: 4.46; 95% CI:1.21-16.46) when compared to those who had less than High School education, and this association was statistically significant (p=0.02).

V. DISCUSSION AND CONCLUSION

5.1 Discussion

Risk perception in regards to perceived susceptibility refers to an individual's assessment of risk of developing a specific health problem (Janz & Becker, 1984). When it is about pregnant women and ZIKV, their concern about ZIKV could play a crucial role in influencing their ZIKV preventative health behaviors during pregnancy. Therefore, it is important to examine the concern of pregnant women as this could provide potential insight for development of targeted interventions for prevention of ZIKV infection and thus have public health implications for maternal and child health.

This study aimed to gain an understanding of concern about ZIKV among women in Georgia with live birth in 2017 and to examine the behavior of condom use among those who were sexually active during their most recent pregnancy. The results of this study showed that less than half of women in Georgia were concerned about getting infected with ZIKV and this distribution of concern was significantly different by race/ethnicity, maternal level of education, maternal age and marital status of these women.

Few (11.5%) of these women never heard about ZIKV in Georgia. Overall, less than 10% of Georgian women with recent live birth in 2017 consistently used condoms when having sex during pregnancy. Further, the behavior of consistent condom use during pregnancy was more common among those that were of Hispanic race/ethnicity, those who had higher education level and among those who were not married. The finding of low percentage of ZIKV concern among women in Georgia could be due to many possible reasons. One reason could be perhaps due to their lack of awareness about ZIKV infection. Another could be because their health care providers did not talk to them about ZIKV infection when providing prenatal care. Other possible explanation could be since ZIKV infection is asymptomatic in 80% of the cases and self-limiting, many of these women may not have felt themselves to be at risk. Further, there had been no local autochthonous transmission of ZIKV in Georgia at the time of the study and so these women may not had felt at risk.

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 nearly all women (93.4%) who had live birth in 2016 reported being “somewhat worried” or ”very worried” that they would contract ZIKV. The relative higher percentage of concern about ZIKV among women in Puerto Rico when compared to women in Georgia is not unusual, as there was a large outbreak of ZIKV in Puerto Rico from January 2016 to March 2017 that affected more than 3000 pregnant women (Simeone et al., 2016). In addition, cases of ZIKV in Puerto Rico were locally acquired, unlike Georgia where cases of ZIKV were travel-related (Simeone et al., 2016).

A similar finding of higher percentage of personal concern about getting infected with ZIKV was noted among those women desiring pregnancy (86.7%) when compared to those who were not considering pregnancy (47.7%)(Curry et al., 2018). It is noted in the study that majority (89.8%) of these women had received information on ZIKV from media and television outlets (Curry et al., 2018). Further, the study was conducted during the four weeks immediately following the announcement of local ZIKV transmission (Curry et al., 2018). This current study cannot determine if personal concern of ZIKV was associated with the awareness and knowledge of ZIKV among women in Georgia due to limitations in the survey design.

The results from this current study suggested a low percentage of women using condoms consistently when having sex during pregnancy. The reason for this is unknown. A study conducted among travelers from United States found that knowledge of the sexual transmissibility of ZIKV significantly increased the odds of taking a preventive action against Zika infection, especially condom use or sexual abstention (Nelson, Luetke, McKinney, & Omodior, 2019). This current study could not explore the association between knowledge of sexual transmissibility of ZIKV among these women and their condom use behavior, as there were limitations in design of the study questionnaire.

Another finding of this current study is that personal concern of ZIKV infection among women in Georgia was not associated with consistent condom use among sexually active respondents during pregnancy. This finding was supported by a study conducted by Guerra-Reyes, 2018 that assessed variability of condom use in a nationally representative sample of sexually active adults in the United States which found that condom use was not significantly associated with ZIKV concern (Guerra-Reyes et al., 2018).

The finding that women of Hispanic race/ethnicity in Georgia were more likely to use condoms consistently when having sex during pregnancy is positive and encouraging as this has implications for prevention of all sexually transmitted diseases including ZIKV. But what are the reasons for this consistent condom use behavior among women of Hispanic race/ethnicity? There are no clear answers to this question.

There is evidence in the literature to show that condom use varies by demographic factors such as age, race and ethnicity, education, and relationship status (Reece et al., 2010). In addition, various contextual factors could be associated with condom use, including attitudes toward condoms, levels of perceived risk of sexually transmitted diseases, beliefs about one's ability to conceive, and self-efficacy regarding the negotiation of condom use between partners (Grady, Klepinger, Billy, & Cubbins, 2010; Pollack, Boyer, & Weinstein, 2013; Shih et al., 2011).

A study conducted by Quadagno, Sly, Harrison, Eberstein, & Soler, 1998 found that sexual decision making about condom use varied among Black, Hispanic and white women. It is possible that these differences in sexual decision-making may have attributed to their behavior of consistent condom use among women of Hispanic race/ethnicity in this study. However, it is noteworthy to highlight that Non-Hispanic White women were found not to be consistently using condoms when having sex during pregnancy. This study does not explore the reasons why this is so. Possibly Non-Hispanic White women may be using other methods for contraceptive use as it is evident in the literature that there is variation in contraceptive use across social and demographic characteristics. According to data reported from 2011-2013 National Survey of Family Growth in women aged 15-49 years, the pill was the most common contraceptive method used among non-Hispanic White (29%) when compared to Hispanic (19%) and non-Hispanic black women (17%).

This study found that respondents who were unmarried were more likely to use condoms when having sex during their pregnancy; a finding supported by a study (Frost & Darroch, 2008) that showed condom use was more common among unmarried women than among their married counterparts (39% vs 31%). Similar finding of higher levels of condom use was more common among adults that were in casual relationships then those that were in steady relationships (Sharon, Diane, Mary, & Michael, 1995)

It was found in this study that sexually active women who had "Some College" level of education were more likely to consistently use condoms during their pregnancy (adjusted odds ratio:4.46; 95% CI:1.21-16.46) when compared to those who had less than High School education and this association was statistically significant (p=0.0247). This is in contrast to a similar study conducted using PRAMS methodology in Puerto Rico, which showed that the prevalence of consistent condom use was higher for sexually active women with a high school diploma or less during pregnancy (25.2% vs. 19.2%; adjusted Prevalence Ratio: 1.31, 95% CI: 1.07–1.60) when compared to those women who had more than a high school education. Possibly, this higher prevalence of consistent condom use for less educated women could be because most (86.8%) women in this study (Salvesen von Essen et al., 2019) reported receiving counseling to use condoms during pregnancy to prevent ZIKV infection.

5.2 Study Strengths and Limitations

One of the strengths of this study is that the response rate was 70%, which exceeded CDC's required threshold of 55% for 2016-2017. The study sample is stratified so that subpopulations of public health interest can be oversampled, such as mothers of low-birth-weight infants, those living in high-risk geographic areas, and racial/ethnic minority groups. In addition, the data are weighted so the findings could be generalized to population of Georgia.

However, this study has some limitations.

First, data are not representative of all pregnancies in Georgia. This study excludes induced pregnancies and fetal deaths from the sample. 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 ZIKV 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.

5.3 Conclusions

It is important to gain an understanding of concern about ZIKV among women in Georgia as this could have public health implications for maternal and child health with regards to prevention of ZIKV infection. The distribution of concern about ZIKV in Georgian women with live birth in 2017 varied across their demographic characteristics. Consistent use of condoms during pregnancy appears to vary by demographic factors in this study with regards to race/ethnicity and relationship status and was not associated with concern about ZIKV among these women in Georgia. Currently, the threat to ZIKV is low in Georgia, but this is not guaranteed, therefore the findings of this study point to opportunities for engagement on ZIKV awareness and help with refining risk messaging for prevention of ZIKV in pregnant women. In addition, findings of this study could help to implement programs that focus on addressing cultural barriers that might hinder preventative behaviors such as condom use which would reinforce the behavior of consistent condom use to prevent sexual transmission of ZIKV during pregnancy.

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7. TABLES

Table 1: Sample characteristics (N=955) Georgia Pregnancy Risk Assessment Monitoring System 2017

Characteristics	Unweighted Total N	Weighted Total N / Median	Weighted (%) (95% CL) or IQR**
Age years	**955**	**29**	25-33
Education	**949**	123742	
Less than High School	135	16714	13.5% (10.4-16.5)
High School Grad	279	34932	28.2% (24.0-32.3)
Some College	250	28370	22.9% (19.0-26.7)
College grad	285	43726	35.3% (30.9-39.7)
Missing- 6			
Mother's Race/Ethnicity	**949**	123176	
NH White	355	51419	41.7 % (37.2-46.2)
NH Black	414	41551	33.7% (29.3-38.0)
Hispanic	130	20263	16.4(13.2-19.6)
NH Other	50	9943	8.0(5.5-10.6)
Missing -6			
Married	**955**	124419	
Yes	548	74624	59.9% (55.5-64.4)
No	407	49795	40.0% (35.5-44.4)
Maternal county of residence	**939**	123514	
Urban	766	103896	84.1% (80.7-87.4)
Rural	163	19618	15.8% (12.5-19.2)
Missing-16			
Income in the 12 months before delivery	**790**	102708	
<$[1]20,000	259	30372	29.57% (24.9-34.1)
$20,000-36,000	152	18402	17.9(14.0-21.8)
$36,000-$48,000	100	12476	12.1% (8.8-15.3)
$48,000 or more	279	41459	40.3% (35.4-45.2)
Missing- 165			

[1]-USD: US dollars
****- Inter-Quartile Range**
Note: Missing data have been excluded from analysis

Table 2a: Socio-demographic characteristics of participants by concern of ZIKV (N=940) Georgia Pregnancy Risk Assessment Monitoring System 2017

Participant Characteristics	**Concerned**	**Not Concerned**	**Never heard about ZIKV**	**Total**	**Chi-square p-value**
Total N (%)	**418 (47.4%)**	**403 (41.0%)**	**119 (11.5%)**	**940 (98.4%)**	
	N (%) * 95%CI	**N (%) * 95%CI**	**N (%) * (95%CI)**	**N (%)**	
Age, years					
<20 years	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 years	158(42.1) (35.5-48.7)	180(48.9) (41.6-56.1)	67(59.7) (46.5-73.0)	405(46.9)	<0.0001**
30 years 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)	
Missing =15					
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)	
Missing=21					
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)	0.0002**
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)	
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)	
Missing=21					
Married					
Yes	67.6 (61.3-73.8)	56.8 (49.6-63.9)	38.2 (25.1-51.3)	539(59.7)	0.0003**
No	32.3(26.1-38.6)	43.1 (36.0-50.3)	61.7 (48.6-74.8)	401(40.2)	
Missing= 15					

***column percentages**
**** A *p*-value ≤ 0.05 was considered statistically significant**
Note: Income level of the women was not included as a variable for analysis due to missing data
Note: Missing data have been excluded from analysis.

Table 2b: Socio-demographic characteristics of participants by consistency of condom use when having sex during pregnancy, Georgia Pregnancy Risk Assessment Monitoring System) 2017 (N=844)

Participant Characteristics	Consistent	Not Consistent	Total	Chi-square p-value
Total N (%)	75 (8.7%)	769(91.2%)	844(99.9%)	
	N (%) * 95%CI	N (%) * 95%CI	N (%)	
Age, years				
<20 years	4(10.1) (0.42-19.8)	30(5.5) (3.1-7.9)	34(5.9)	
20-29 years	27(35.2) (20.1-50.2)	340(49.5) (44.5-54.6)	367(48.3)	
30 years or older	44(54.6 (38.8-70.4)	399(44.8) (39.8-49.8)	443(45.7)	0.1828
Missing =111				
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
Missing=116				
Mother's race/ethnicity				
NH White	13(17.) (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)	
Missing=116				
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**
Missing= 111				
Level of concern of ZIKV				
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)	0.3998
Never heard of ZIKV	9(8.6) (0-17.4)	87(11.7) (8.4-14.9)	96(11.4)	
Missing: 113				

***column percentages**
**** A p-value ≤ 0.05 was considered statistically significant**
Note: Missing data have been excluded from analysis, This data does not analyze those who never had sex during pregnancy

Table 3: Crude Unadjusted and Adjusted Odds ratios of selected participant characteristics by those who use condoms consistently when having sex during pregnancy

Participant Characteristics	Consistent use of condoms N=75			
	Crude OR[1] (95% CL)	**p-value**	**AOR[2](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)**	**0.0479*** **
30 years or older	**Reference**		**Reference**	
Maternal Education level				
Less than High School	**1.50(0.51-4.36)**	**0.4567**	**0.40(0.10-1.55)**	**0.1882**
High School grad	**1.83(0.75-4.44)**	**0.1802**	**1.14(0.36-3.60)**	**0.8141**
Some College	**1.46(0.55-3.86)**	**0.4391**	**1.81(0.60-5.43)**	**0.2886**
College	**Reference**		**Reference**	
Maternal Race/Ethnicity				
NH White	**Reference**		**Reference**	
NH Black	**1.477(0.48-4.47)**	**0.4899**	**1.02(0.32-3.16)**	**0.9707**
Hispanic	**11.235(4.37-28.83)**	**<0.001**	**11.379(3.94-32.84)**	**<0.001*** **
NH Other	**3.349(0.80-13.96)**	**0.097**	**3.352(0.78-14.40)**	**0.1038**
Married				
Yes	**Reference**		**Reference**	
No	**2.055(1.04-4.03)**	**0.0365**	**1.811(0.75-4.32)**	**0.1813**
Level of concern of ZIKV				
Concerned	**1.699(0.51-5.66)**	**0.8941**	**0.899(0.21-3.70)**	**0.8830**
Not Concerned	**1.089(0.30-3.84)**	**0.3874**	**0.666(0.17-2.50)**	**0.5473**
Never Heard of ZIKV	**Reference**		**Reference**	

1 Odds Ratios
2 Adjusted Odds Ratio (adjusted for covariates such as maternal race/ethnicity, maternal education and marital status of moms & ZIKV concern level)