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RESEARCH PAPER



Maternal stress and the ZIKV epidemic in Puerto Rico

Holly Horan ^a, Melissa Cheyney ^b, Eni Nako^c and Marit Bovbjerg ^d

^aUniversity of Alabama, Tuscaloosa, AL, United States of America (USA); ^bDepartment of Anthropology, Oregon State University, Corvallis, OR, United States of America (USA); ^cSchool of Medicine, Oregon Health Science University, Portland, OR, United States of America (USA); ^dCollege of Public Health and Human Sciences, Oregon State University, Corvallis, OR, United States of America (USA)

ABSTRACT

In the summer of 2016, we examined the impact of the ZIKV crisis on women's experiences of perinatal stress in Puerto Rico. Twenty-two pregnant or recently postpartum women engaged in qualitative interviews designed to elicit experiences of stress and pregnancy. Three key themes emerged from the interviews: 1) *'Every day I think that it was invented: Skepticism of official messaging about ZIKV;* 2) *'I worried about mosquitoes all the time': Fear of ZIKV-related birth defects;* and 3) *'What am I going to do?': ZIKV as a compounding maternal stressor.* Public health ZIKV education campaigns inadvertently sent the message that attempting to avoid ZIKV was futile. In response, women focused on more immediate, tangible life stressors and questioned the anti-natalist objectives of Puerto Rican and US health authorities. Any public health messaging that recommends delaying or preventing pregnancy must consider how such messaging might be received in a post-sterilization society. Prioritizing preventive measures – such as removing standing water – is essential for building trust in this colonial context.

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Introduction

By 2016, Puerto Rico accounted for 85% of all Zika virus (ZIKV) infections in the United States (US) and its territories. Puerto Rico also reported the first ZIKV-associated case of microcephaly in the US (Pan American Health Organization (PAHO) & World Health Organization (WHO), 2018; Rodríguez-Díaz et al., 2017). ZIKV's primary mode of transmission is mosquito-borne, though cases of sexual transmission have also been documented (D'Ortenzio et al., 2016; Mansuy et al., 2016). ZIKV is mild in virulence compared to other common arboviruses in Puerto Rico like dengue fever and chikungunya. However, vertical transmission of ZIKV leads to an increased risk for poor fetal and neonatal health outcomes including microcephaly, brain abnormalities, and central nervous system dysfunction (D'Ortenzio et al., 2016; Meaney-Delman et al., 2016; Rodríguez-Díaz et al., 2017). Aggressive public health messaging in Puerto Rico focused on amelioration of these adverse infant outcomes by promoting contraception for the temporary delay of childbearing (Lathrop et al., 2018).

Qualitative investigations of the perception of ZIKV risk and risk management in women of reproductive age in Latin America, though few, critically examine the degree to which birthing people engage in disease prevention behaviors that represent a complex interplay between individual decision-making and socio-historical influences (Marteleto et al., 2017). Research in Iquitos, Peru shows that while ZIKV symptoms are well-known, fatalistic perceptions, a lack of knowledge related

to modes of transmission, gender inequity in intimate partnerships, and inadequate and impersonal public health approaches contributed to reduced uptake of preventive practices (Weldon et al., 2018). In Brazil, whose northeastern region was disproportionately affected by ZIKV-associated microcephaly (Marteleto et al., 2017), socio-economic status shaped perceptions of ZIKV risk and subsequent health behaviors. Issues including contraception availability, access, and use, the postponement of pregnancy, reproductive autonomy, and stigma associated with condoms were universal; in Brazil, these concerns were significantly associated with class status. These prior studies highlight the value of qualitative investigations and that successful public health campaigns need to be contextualized within the unique socio-historical determinants of health and reproductive decision-making strategies of the specific area.

Researchers and clinicians often view pregnancy as an 'opportune time for intervention' because pregnant individuals are experiencing a life transition and typically have increased contact with health care providers (Dinsdale et al., 2016, p. 1). For example, Dinsdale et al. (2016) described participants' experiences with maternal obesity care interventions. Participants indicated that providers had a limited understanding of the lived experience of their weight gain, the appropriate terms used to describe body size, that generic nutrition and exercise advice was ineffective, and that there was an absence of postnatal support for healthy weight maintenance (2016). Participants also provided feedback on the types of services and supports that were most beneficial, demonstrating how qualitative analysis can serve as a thorough, quality improvement tool.

Mubyazi et al.'s (2005) work in Tanzania revealed that despite significant knowledge of malaria and its symptoms, pregnant women's treatment seeking behaviors did not comply with the intermittent preventive treatment strategy recommended by the Tanzanian government. Participants described their hierarchy of resort for health care seeking behaviors related to malaria; these included a combination of traditional and biomedical health care options and over-the-counter pharmaceuticals. Women defended this approach by describing how their greatest concerns resulted from the poor quality of health care services and mistreatment by health care staff (Mubyazi et al., 2005, p. 6). They also expressed concerns about the lack of information on standard malaria prophylaxis and its side effects. Collectively, these qualitative assessments demonstrate a cross-cutting theme: understanding the lived experience of the patient within the local context of the health system is central to evaluating perceived risk and the effectiveness of public health messaging campaigns and interventions.

Qualitative research has the potential to transform public health, health research, and public health policy when it is coupled with a holistic, applied framework. Critical medical anthropology (CMA) employs a multi-level approach to understanding and responding to human health problems and in identifying how these problems emerge at the intersections of the political-economy, the health care system, the environment, the community, and the individual (Singer, 1995). This framework is inherently political, calling attention to the interactions between social inequities related to class, race, gender, and sexuality and the role that power plays at these intersections to influence the distribution of health and disease (1995). Rather than serving as strict metatheory, this approach aims to '... to change culturally inappropriate, oppressive, and exploitative patterns in the health arena and beyond,' viewing a '... commitment to change as fundamental to the discipline' (p. 81).

Campbell (2011) further describes how anthropological approaches can influence public health policy in ways that epidemiology and other disciplines cannot. Anthropologists are well-positioned to '... document and contextualize the effectiveness of health services as they impact people's lives' (Pfeiffer et al., 2008, p. 412). The combined reliance on holism, culture as a lens, the critical analysis of hegemonic ideologies, and the use of qualitative and ethnographic methodologies allows critical medical anthropologists to gather robust data about health beliefs and behaviors that can inform and improve public health interventions. For this study, we employed a critical medical anthropological framework to examine how power and structural inequality have shaped maternal perceptions of stress and ZIKV during pregnancy in Puerto Rico. Given the lack of vaccination or treatment options, women of reproductive age in Puerto Rico and other ZIKV-endemic areas must choose between

delaying childbearing in the hopes that vaccines or effective treatments are forthcoming or risk a ZIKV-affected pregnancy. Therefore, we inquired about how the potential stress of the latter choice manifest in women's daily lives. Currently, there is no standardized definition of maternal stress; however, many studies define maternal stress as a consequence of the '... psychological disorders of depression and anxiety' (Rallis et al., 2014, p. 68) as they appear in the prenatal and postpartum periods (Falah-Hassani et al., 2017; Farr et al., 2014; González-Mesa et al., 2020). In our search for a definition of maternal stress that sufficiently captured the maternal experience in Puerto Rico, we adapted Emmanuel and St John (2010) definition of *maternal distress*: '... a woman's response to ... changes to their bodies, roles, relationships and social circumstances; birth experiences; and the demands, challenges, and losses and gains associated with being a new mother' (p. 2111). At the height of the ZIKV epidemic in Puerto Rico in August of 2016, we completed 22 open-ended, semi-structured interviews with pregnant and recently postpartum women as part of a larger research project. Participants' responses reveal complex narratives of being pregnant during the peak of the ZIKV epidemic and how concerns about ZIKV in Puerto Rico are intertwined with larger issues of political-economic precarity.

Methods

Data collection occurred during phase I (August to September 2016) of a larger, two-phase study that spanned 16 months of fieldwork between August 2016 and March 2018. In total 22, women over the age of 17 years who were either pregnant or within six weeks postpartum, were eligible to participate and recruited using non-probability quota sampling (Bernard, 2011). These women were recruited through a local maternal and infant health community-based organization and a hospital-based, non-profit breastfeeding support group in San Juan, Puerto Rico. All study materials and interviews were available in English and Spanish. Pseudonyms replace participants' names to protect their confidentiality. This project was approved by the Institutional Review Board at Oregon State University.

After providing verbal informed consent, participants completed a brief eligibility survey asking how many weeks pregnant or postpartum they were. Two researchers co-conducted semi-structured interviews in-person or by telephone. Interviews were carried out in Spanish ($n = 15$) and English ($n = 7$). An interview guide was created first in English and then translated and back-translated in Spanish to promote consistency between the two versions (Shigenobu, 2007). Interviews were audio recorded with the participants' consent, de-identified, and transcribed verbatim. Interviews conducted in Spanish were transcribed and then translated into English and reviewed again by the each of the authors. The average interview duration was 30 minutes.

The first three authors analyzed the interview narratives, identifying representative, recurring themes that described mothers' experiences related to ZIKV, stress, and pregnancy (Vaismoradi et al., 2013). Open, consensus coding, wherein each researcher independently codes the transcripts producing a preliminary list of topical and theoretical codes or concepts, was used to identify key themes in the interview transcripts (Creswell & Poth, 2013). We engaged in consensus coding because it allowed for a diverse range of codes to emerge from participant narratives, as researcher positionality is known to influence which themes are identified and prioritized and which were overlooked (Maxwell, 2013). In addition, the use of multiple coders has been shown to add rigor to qualitative data analysis making it more likely that findings will accurately and dependably reflect the range of experiences conveyed in interviews (Bernard, 2011; Creswell & Poth, 2013).

We developed preliminary lists of codes independently, then came together to identify overlapping themes and to discuss non-overlapping themes until we reached consensus. Representative themes were identified by the authors as concepts that were ubiquitous across the interviews and that had achieved concept saturation. Parameters for achieving concept saturation are contingent upon the expertise of the research team, the sampling methods, as well as the homogeneity of the phenomenon and the population under study (Guest et al., 2006). Once we identified the representative themes that had achieved concept saturation, the first three

authors then re-coded the transcripts using these themes to identify the commonalities and variations within and among them (Table 1).

Results

Twenty-two pregnant ($n = 11$, representing all three trimesters) and recently postpartum ($n = 11$) Puerto Rican women completed the interviews. Three key themes emerged from the participants' narratives: 1) *'Every day I think that it was invented': Skepticism of official messaging of about ZIKV*; 2) *'I worried about mosquitoes all the time': Fear of ZIKV-related birth defects*; and 3) *'What am I going to do?': ZIKV as a compounding maternal stressor*. Emergent themes are both interconnected and sometimes contradictory, revealing the complex ways ZIKV threats were navigated during pregnancy and how it exacerbated existing stressors. Participants' narratives indicate that both perceptions and health behaviors associated with ZIKV are deeply influenced by Puerto Rico's colonial reproductive history.

'Every day I think that it was invented': skepticism of official messaging about ZIKV

The theme of distrust related to ZIKV messaging emerged largely around an explicit lack of faith in the local Puerto Rican government and a profound skepticism over US public health entities' intentions. The historical and contemporary colonial relationship between the US and Puerto Rico, as well as the history of what many see as anti-natalist policies toward Puerto Rico, combined to produce significant distrust around ZIKV messaging among women in this study. Mothers described feelings of uncertainty, questioning whether the ZIKV threat was 'even real.' Thinking of ZIKV as a fabricated threat, for example, allowed Julia, a physical therapist pregnant with her second child, to reduce stress for herself and her family. When describing her daughter's concerns, Julia said: 'She [her older daughter] goes, "mama take care of yourself, of the Zika." And I just assured her, "Baby, that was made up by humans, for political reasons, so don't worry about Zika.''

Mothers' skepticism around ZIKV was also related to how information was dispersed by the media. Some participants argued that they needed access to 'unbiased information' but that this was nearly impossible to find. Linda, a 32-year-old pregnant with her second baby, who was employed full-time as a clinic manager, described how clinical information about ZIKV was distributed on the island:

"It's not the same to give you information without any emotional aspect of my own opinion (unbiased information), to give you information just to educate yourself, or allow you to make your own decisions. Here, we don't do that. We just give you information in a way that makes you change your point of view to mine. So that part, the manipulation, that is what brings me stress."

Liana, a college student, in the first trimester of her first pregnancy, argued that in combination with a lack of reliable information, the media's portrayal of ZIKV was to blame for 'the local and global hysteria,' saying: 'The status of the country [Puerto Rico], everything makes you worry. Really, it's the media. What they make of it [the ZIKV threat], that is the problem.' When watching the local news or driving on major highways, there were billboards with an image of a large mosquito biting human flesh that said *'si te pique, se complica'* ('if it bites you, it becomes complicated'). These advertisements often had limited additional information on how to reduce transmission and few if any publicly displayed messages about preventing sexual or vertical transmission. Participants described local, public health messaging efforts as producing widespread fear and panic without reducing transmission.

Living in a post-sterilization society (Briggs, 2002; López, 2008; Schoen, 2005) many Puerto Rican women are skeptical of health campaigns supported by the US government, especially when they aim to curb reproduction. Celeste, a birth activist, perinatal health care provider, and community leader, reflected: 'So, we have had other mosquito-borne illnesses for a long time, like dengue and

chikungunya, and now all of a sudden we should delay childbearing and tourists should not come here ... this is suspicious to us.' In response to rising ZIKV diagnoses, a local association of reproductive health care providers initiated a program that offered free contraception to delay pregnancy, including long-lasting forms, oral contraceptives, and condoms (Lathrop et al., 2018). Despite the advertised intent to empower women through reproductive decision-making, this program increased Puerto Rican women's suspicions about ZIKV, as they felt reminiscent of past sterilization campaigns (Briggs, 2002; López, 2008; Schoen, 2005).

The limited availability of certain public health resources in Spanish added to participants' concerns as many noted a lack of accessible and reliable information. Participants reported encountering a vast amount of public health information related to ZIKV from the news, printed fliers, newspaper advertisements, articles, billboards, and health care providers. However, on the Centers for Disease Control and Prevention's (CDC's) *Print Resources* page for ZIKV (2018), information on ZIKV basics, mosquito-bite prevention, and mosquito control are available in both English and Spanish. Other documents from the CDC were available only in English, including information on ZIKV and sexual transmission, testing, and the interpretation of test results for a suspected infection. Information on counseling travelers and next steps following a positive diagnosis were also available exclusively in English. Though mothers never explicitly mentioned checking the CDC web page, many of its printed materials were available in popular and high-traffic public locations. In addition, ZIKV prevention fliers were commonly posted in English only at high-traffic tourist locations even though both tourists and locals frequented these sites. The inaccessibility of this information for Spanish speakers in Puerto Rico contributed to what one participant called 'insidious messaging' wherein women questioned 'who was really being protected from ZIKV' – the Puerto Rican people themselves, or English-speaking tourists?

'I worried about mosquitoes all the time': fear of ZIKV-related birth defects

Many participants were skeptical of ZIKV public health messaging and the media, yet all were stressed about microcephaly and its potentially life-altering consequences – a risk that was nearly impossible to quantify. Though not all ZIKV-related educational initiatives were known to or clearly understood by participants, the threat of birth defects had reached mothers loud and clear. The additional stress that participants experienced because of ZIKV was described as negatively affecting their daily lives, especially during their routine prenatal care visits. Coral, a 31-year-old, first-time mother, and pharmacist, described the anxiety that she and her partner experienced during each ultrasound:

"It was very scary and frustrating that a mosquito would bite me. Every time I would go do a sonogram, I wanted to make sure that the baby was well, that the baby was developing well, that the baby wouldn't have problems ... every time that we had a sonogram, my husband would be even more stressed than me. We needed to know that the head was the average measurement and that everything was going alright."

Paz, a 35-year-old first time mother with a PhD, spoke about her desire to give birth to a healthy baby as soon as possible: 'That is a topic that has given me a lot of stress this pregnancy – Zika. In fact, I want to give birth already, to avoid exposing myself to the disease ... Well, I kind of want to give birth now. At least, I want the days to go by fast, so the baby doesn't come out affected.' Participant's desire to 'give birth as soon as possible' is particularly concerning. After mid-gestation, the risk of a prenatal ZIKV-related microcephaly infection diminishes (Alcantara & O'Driscoll, 2014). Participants' desire to be induced even after this timeframe is potentially dangerous in Puerto Rico specifically, where the hyper-medicalization of pregnancy already has contributed to elevated rates of poor maternal and infant health outcomes, including non-medically indicated inductions leading to iatrogenic preterm birth (Centers for Disease Control and Prevention, 2020).

'What am I going to do?': ZIKV as a compounding maternal stressor

Mothers expressly described ZIKV as a lower priority than daily issues related to 'finding money and resources to survive the general stress' of daily life. Many believed that ZIKV was potentially a threat to their health but viewed worrying about ZIKV as a similarly unhealthy stressor. Daya, a 30-year-old first-time mother, who was unemployed and early in her second trimester, highlighted the practicality of this sentiment saying: 'You can do your part, but you cannot manipulate what will happen. How can you keep a mosquito from biting you in this environment? You can only do what you can do.' For her, the stress of 'being preoccupied with something that you can't change,' while living in a humid, tropical environment, was a greater threat to her wellness during pregnancy. Jessica, a stay-at-home mother 33 weeks pregnant with her second baby, described her frustration with the unrealistic expectations of ZIKV prevention beyond taking basic precautions: 'What am I going to do? Put repellent on my face, go out with a bag [over my head], what am I going to do?'

While ZIKV-related stress emerged as a common theme, it is also noteworthy that some never mentioned it as a stressor until specifically asked. Zulimar, a 37-year-old teacher in the early postpartum period with her first baby, reflected on the stress ZIKV caused in her pregnancy after being prompted: 'Now that you mention it, you do not know if you are stung by a mosquito that has it [ZIKV], this also caused me a lot of stress.' Zulimar, like other mothers who worked outside of the home, reflected on the stress of working long hours while pregnant, and the lack of adequate maternity leave policies. These were for her, by far, the biggest daily stressors. The focus on ZIKV was recognized by many as a way of diverting attention from 'bigger issues.'

Participants conveyed that stress in Puerto Rico flowed from numerous sources, and ZIKV is only one of them. Even though the ZIKV threat clearly added additional stressors to participants' lives, it was not the primary concern for most of them. Instead, persistent issues such as poverty, under-employment, traffic, urban congestion, pollution, expensive yet low quality food, and contaminated water were primary stressors. Mothers were acutely aware of the political and economic changes related to Puerto Rico's default on the island's 70 USD billion debt and the subsequent forced financial oversight of the island (Perreira et al., 2017). This major political-economic disruption left many feeling vulnerable as they anticipated cuts to education, health care, and employment, as well as a potential change in the island's territory status. June, a 24-year-old unemployed mother in her third trimester, summarized this concern: 'Sometimes the stress is related to the burden of not knowing what is going to happen next here.'

Discussion

Participants described ZIKV as a conflicting and compounding stressor in Puerto Rico – a perspective shaped by the island's colonial reproductive history, social expectations, and on-going political-economic crisis. Participant narratives show that maternal concerns related to socio-economic vulnerabilities outpaced institutional concerns related to ZIKV. Maternal fears were not well understood by public health officials, and thus, were ineffectively addressed in ZIKV informational campaigns. Public health messengers failed to appreciate the degree to which every day economic factors are interwoven with perceptions of other pregnancy risks, including ZIKV. The impact of ZIKV on mothers' stress levels was caused not only by a fear of birth defects, but also by feeling out-of-control, without reliable clinical information related to transmission, risk, or testing, and the impractical instructions to avoid all contact with mosquitoes or delay childbearing indefinitely.

Puerto Rico's colonial reproductive history shaped women's perceptions of public health measures designed to 'prevent' ZIKV infection. Puerto Rico has experienced centuries of colonial rule (Briggs, 2002; López, 2008; Schoen, 2005), resulting in large political and economic disparities. Racism, classism, and xenophobia have been used to justify aggressive, experimental 'reproductive health' programs in the form of forced sterilization and unconsented high-dose hormonal birth

control. Given this history, public health messages aimed at preventing or delay childbearing during the ZIKV epidemic were met with skepticism and mistrust. Here, we identify ZIKV as a postcolonial disorder – a condition or ‘disorder’ that occurs within the context of a ‘haunting presence of colonial trauma’ (Good et al., 2010). Mothers responded to ZIKV as a post-colonial disorder by both resisting and accepting its threat during their pregnancies.

Puerto Rico’s unintended pregnancy rate in women of reproductive age (15 to 44 years old) who are not using an effective form of contraception is estimated to be more than 66% or 138,000 pregnancies (Tepper et al., 2016). The island struggles with limited access to contraception due to the excessive cost, health care reimbursement issues, and a lack of trained providers among other barriers (2016). A recent survey of contraception utilization in a predominantly low-income sample revealed that oral contraceptives were the primary method used (80%) despite access limitations (Puerto Rico Title V Application, 2010–2011; Tepper et al., 2016). In response to rising ZIKV diagnoses, a local association of obstetricians and gynecologists initiated a program that offered free contraception to delay pregnancy. Outcomes from this program report that 68% of participants (n = 21,124) chose a long-acting option and only 4.5% declined contraception (Lathrop et al., 2018). However, this means that more than 100,000 individuals remained at risk for unintended pregnancy without easy access to a range of contraceptive options, suggesting a limited utility of public health efforts to reduce or delay childbearing even if women were to believe the messages.

Participants’ ZIKV concerns illustrate complicated positionalities wherein women navigate between a state of political distrust and fear associated with trying to protect their fetuses from a threat beyond their control. Participants typically relied on ultrasound measurements to reassure them that they were carrying a fetus without congenital anomalies. While some researchers have argued that ultrasonography is not an overly sensitive method for detecting congenital anomalies such as microcephaly, especially before 18 to 20 weeks gestational age (Leibovitz et al., 2016), ultrasounds nonetheless provided participants with a sense of security. Mothers’ dependence on biomedical technologies and fear of a ZIKV diagnosis co-existed in a context where the medicalization of childbirth has significantly and detrimentally influenced perinatal health outcomes. When comparing Puerto Rico to the US states, excessive medicalization is evidenced by the high rates of elective induction (11% versus 2%), preterm birth (11.4% versus 9.6%), and nulliparous, singleton, term vertex (NSTV) cesarean birth (40.6% versus 26%) (Association of Maternal and Child Health (AMCHP), 2018; CDC, 2020; Horan et al., *Forthcoming*). Despite this paradox, ultrasounds provided some peace of mind during the ZIKV epidemic for families.

The effectiveness of public health messaging related to ZIKV in Puerto Rico was called into question by participants because it attempted to employ a ‘delay pregnancy’ approach in a population that is acutely aware of its colonial history and resulting inequities. Such suspicions were strengthened by reports of more effective campaigns in neighboring Cuba, where a community-based program reportedly eradicated ZIKV by prioritizing the elimination of standing water sites (Neely, 2016). During our study, nearly half of the entire pregnant population in the US diagnosed with ZIKV were asymptomatic (Departamento de Salud de Puerto Rico, 2017); this fact provided an additional opportunity for suspicion. Public health education often focuses on personal responsibility – a perspective that, if not carefully navigated, can result in ‘victim blaming’ even though a number of variables are out of an individual’s control (Laverack, 2019, p. 4). Victim blaming is not a new phenomenon; women have been held responsible for poor infant health outcomes in myriad ways throughout history (Bell et al., 2009; Richardson et al., 2014; Winett et al., 2016). However, as Winett et al. (2016) have argued, pregnant individuals exist within a broader context and without careful consideration, behavioral health interventions risk stigmatizing, scapegoating, and/or increasing the surveillance and regulation of women’s bodies (Richardson et al., 2014; Winett et al., 2016).

The predominance of public health messaging in English on a predominantly Spanish-speaking island likely reflects a desire to salvage the tourism industry by prioritizing the protection of tourists over the health information needs of inhabitants. Certainly, Puerto Rico’s tourism industry was in

danger when the island was perceived as a hot bed for ZIKV virus transmission to US states (Branswell, 2017). These circumstances can be compared to other examples, such as the island Caye Caulker of Belize where tourism business owners argued that health organizations overreacted to the ZIKV epidemic and ultimately threatened their livelihood (Gray & Mishtal, 2019). This issue of public health messaging related to ZIKV further illustrates the constraints on Puerto Ricans and other people living in colonial nations as they struggle for economic mobility, yet are oppressed by structures that dictate their economy, and ultimately, their physical well-being.

Limitations

Participants were recruited from a largely middle-class, urban area. As such, they likely shared experiences and perceptions that do not represent the realities of all pregnant and recently postpartum women across Puerto Rico. Given this, we were particularly struck by the pervasiveness of political-economic concerns in this relatively privileged sample. We recognize that the experience of the ZIKV threat may have been entirely different for communities with lower resources, particularly for exclusively Spanish-speaking communities living in areas where access to testing and information was less prevalent. Similar concerns related to inequity and access to ZIKV testing, perceived risk and family planning, or reproductive health services have been documented elsewhere in Latin America (Gray & Mishtal, 2019). This body of work reveals the ways neoliberal policies negatively impact perinatal health in marginalized communities.

In addition, the perspectives of pregnant individuals' partners are not included in our analysis of maternal stress and risk related to ZIKV though we recognize that women do not experience stress in isolation. It is likely that partner perspectives shaped women's perspectives of stress and ZIKV risk (Guerra-Reyes & Iguñiz-Romero, 2019). Nonetheless, this study describes how maternal concerns related to ZIKV are embedded in the larger historical and socio-political contexts of women's lives.

Public health implications

Distrust of the public health institutions and governments of both the US and Puerto Rico undermined the intended impacts of ZIKV campaigns. Public health organizations, such as the CDC, acknowledged these challenges, but did not prioritize the availability of all public health materials in both English and Spanish (Frieden et al., 2016). Public health professionals must be sensitive to the historical and cultural contexts of areas that have a known history of reproductive exploitation. They must also pay attention to the ways public health messaging can reinforce and exacerbate global inequities, particularly in a region of the world that is heavily dependent on the tourism industry. Public health messaging will be more effective if it is informed by these social and contextual factors.

Additionally, prioritizing actions such as systematically removing standing water, rather than encouraging contraception, will be necessary to regain trust of disenfranchised communities. In Brazil and Cuba, the political support and resources for the removal and treatment of standing water has been paramount to the mosquito eradication effort (Gorry, 2016; Löwy, 2017). Brazil's anti-*Aedes* campaigns included a multi-level surveillance system that closely monitored the work of sanitary inspectors who conducted weekly home visits in highly affected areas to remove standing water sites and to fine 'repeat offenders' (Löwy, 2017, p. 518). In Cuba, after initial surveillance and fumigation efforts, the island allocated resources to the proactive killing of larvae, treating standing water sites and spraying surfaces with larvicide (Gorry, 2016). Cuban-developed repellent, biolarvicide drops, and in-home foggers were also available for purchase in local stores (p. 9). Given the widespread opposition to fumigation in Puerto Rico (Neely, 2016) and the general distrust of political authorities, we suggest that the most effective approach to the removal of standing water would be to adapt methods from both Brazil and Cuba. The main obstacle for Puerto Rico, however, is the uncertainty related to the political support and allocation of necessary resources to maintain an effective and on-going surveillance system to optimally utilize such public health investments.

Conclusion

Maternal narratives of perinatal stress illustrate that ZIKV exacerbated the effects of existing life stressors in Puerto Rico, and that perceptions of risk associated with ZIKV were influenced by the island's colonial reproductive history. Mothers struggled to contend with this institutional distrust, while also acknowledging the threat ZIKV posed to their fetus, relying on biomedical technologies such as routine ultrasounds to provide them with reassurances about their pregnancy. Public health messaging across the island was perceived as being insufficient and possibly intentionally misleading; in response, mothers focused on immediate stressors that, from their perspective, served as an equal if not greater threat to the health of their pregnancy. Findings from this study illustrate the need to develop public health campaigns that are sensitive to the social, historical, political, and economic contexts of colonial nations.

Disclosure statement

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ORCID

Holly Horan  <http://orcid.org/0000-0003-1577-0369>

Melissa Cheyney  <http://orcid.org/0000-0001-5672-3353>

Marit Bovbjerg  <http://orcid.org/0000-0003-2139-0549>

References

- Alcantara, D., & O'Driscoll, M. (2014). Congenital microcephaly. *American Journal of Medical Genetics*, 166(2), 124–139. <https://doi.org/10.1002/ajmg.c.31397>
- Association of Maternal and Child Health Programs (AMCHP). (2018). *Puerto Rico: State profile*. <http://www.amchp.org/Policy-Advocacy/MCHAdvocacy/2018%20State%20Profiles/Puerto%20Rico%202018%20updated%20narrative%20updated%20SPRANS.pdf>
- Bell, K., McNaughton, K., & Salmon, A. (2009). Medicine, morality and mothering: public health discourses on foetal alcohol exposure, smoking around children and childhood overnutrition. *Critical Public Health*, (2), 155–170. <https://doi.org/10.1080/09581590802385664>
- Bernard, H. R. (2011). *Research methods in anthropology: Qualitative and quantitative approaches* (5th ed.). AltaMira Press.
- Branswell, H. (2017). 'They're just hiding': experts say Puerto Rico may be underreporting Zika-affected births. *Stat News: Health*. Boston: Boston Globe Media. <https://www.statnews.com/2017/04/18/zika-virus-puerto-rico-pregnancies/>
- Briggs, L. (2002). *Reproducing empire: Race, sex, science, and U.S. imperialism in Puerto Rico*. University of California Press.
- Campbell, D. (2011). Anthropology's Contribution to Public Health Policy Development. *McGill Journal of Medicine*, 13(1), 76–83. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3277334/pdf/mjm-1301-076.pdf>
- Centers for Disease Control and Prevention. (2017). *About Adult BMI. US Department of Health and Human Services*. http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html
- Centers for Disease Control and Prevention. (2018). *Print resources: Zika virus*. US Department of Health and Human Services. Retrieved December 17, 2018, from <https://www.cdc.gov/zika/fs-posters/index.html>
- Centers for Disease Control and Prevention. (2020). *Births: Provisional data for 2019*. National Vital Statistics Release, Report 0008. <https://www.cdc.gov/nchs/data/vsrr/vsrr-8-508.pdf>
- Creswell, J. W., & Poth, C. N. (2013). *Qualitative inquiry & research design: Choosing among five approaches* (Third ed.). SAGE Publications Inc.
- D'Ortenzio, E., Matheron, S., de Lamballerie, X., Hubert, B., Piorkowski, G., Maquart, M., Descamps, D., Damond, F., Yazdanpanah, Y., & Leparç-Goffart, I. (2016). Evidence of sexual transmission of Zika virus. *New England Journal of Medicine*, 374(22), 2195–2198. <https://doi.org/10.1056/NEJMc1604449>

- Departamento de Salud de Puerto Rico. (2017). *Reporte ArboV Semana 14-2017*. US Department of Health and Human Services. <http://www.salud.gov.pr/Estadisticas-Registros-y-Publicaciones/Informes%20Arbovirales/Reporte%20ArboV%20semana%2014-2017.pdf>
- Dinsdale, S., Branch, K., Cook, L., & Shucksmith, J. (2016). "As soon as you've had the baby that's it..." a qualitative study of 24 postnatal women on their experience of maternal obesity care pathways. *BMC Public Health*, 16(1), 1–13. <http://bmcpubhealth.biomedcentral.com/articles/10.1186/s12889-016-3289-1>
- Emmanuel, E., & St John, W. (2010). Maternal distress: A concept analysis. *Journal of Advanced Nursing*, 66(9), 2104–2115. <https://doi.org/10.1111/j.1365-2648.2010.05371.x>
- Falah-Hassani, K., Shiri, R., & Dennis, C.-L. (2017). The prevalence of antenatal and postnatal co-morbid anxiety and depression: A meta-analysis. *Psychological Medicine*, 47(12), 2041–2053. <https://doi.org/10.1017/S0033291717000617>
- Farr, S. L., Dietz, P. M., O'Hara, M. W., Burley, K., & Ko, J. Y. (2014). Postpartum anxiety and comorbid depression in a population-based sample of women. *Journal of Women's Health*, 23(2), 120–128. <https://doi.org/10.1089/jwh.2013.4438>
- Frieden, T. R., Schuchat, A., & Petersen, L. R. (2016). Zika virus 6 months later. *JAMA*, 316(14), 1443. <https://doi.org/10.1001/jama.2016.11941>
- Godreau, I. (2000). La semántica fugitiva: "Raza" color y vida cotidiana en Puerto Rico. *Revista de Ciencias Sociales*, (9), 52–71. <https://revistas.upr.edu/index.php/racs/article/view/6083>
- González-Mesa, E., Kabukcuoglu, K., Blasod, M., Körükcü, O., Ibrahim, N., González-Cazorla, A., & Cazorla, O. (2020). Comorbid anxiety and depression (CAD) at early stages of the pregnancy. A multicultural cross-sectional study. *Journal of Affective Disorders*, 270(1), 85–89. <https://doi.org/10.1016/j.jad.2020.03.086>
- Good, B. J., Fischer, M. M., Willen, S. S., & DelVecchio-Good, M.-J. (2010). *A reader in medical anthropology: Theoretical trajectories, emergent realities*. Blackwell Publishing, Ltd.
- Gorry, C. (2016). Cuba confronts Zika: All hands on deck. *International Journal of Cuban Health & Medicine*, 18(1–2), 6–10. <https://www.scielosp.org/article/medicc/2016.v18n1-2/6-10/>
- Gravlee, C.C., Dressler, W.W., & Russell Bernard, H. (2005). Skin color, social classification, and blood pressure in southeastern Puerto Rico. *American Journal of Public Health*, 95(12), 2191–2197. <https://doi.org/10.2105/AJPH.2005.065615>
- Gray, D., & Mishtal, J. (2019). Managing an epidemic: Zika interventions and community responses in Belize. *Global Public Health*, 14(1), 9–22. <https://doi.org/10.1080/17441692.2018.1471146>
- Guerra-Reyes, L., & Iguiñiz-Romero, R. A. (2019). Performing purity: Reproductive decision-making and implications for a community under threat of Zika in Iquitos, Peru. *Culture, Health & Sexuality*, 21(3), 309–322. <https://doi.org/10.1080/13691058.2018.1469790>
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough?: An experiment with data saturation and variability. *Field Methods*, 18(1), 59–82. <https://doi.org/10.1177/1525822X05279903>
- Horan, H., Cheyney, M., Piovanello, Y., & Caldari, V. (Forthcoming). La crisis de la atención de maternidad: Experts' perspectives on the syndemic of poor perinatal health outcomes in Puerto Rico. Human Organization. *Under review*.
- Lathrop, E., Romero, L., Hurst, S., Bracero, N., Zapata, L. B., Frey, M. T., Rivera, M. I., Berry-Bibee, E. N., Honein, M. A., Monroe, J., & Jamieson, D. J. (2018). The Zika contraception access network: A feasibility programme to increase access to contraception in Puerto Rico during the 2016–17 Zika virus outbreak. *The Lancet Public Health*, 3(2), e91–e99. [https://doi.org/10.1016/S2468-2667\(18\)30001-X](https://doi.org/10.1016/S2468-2667(18)30001-X)
- Laverack, G. (2019). *Public health: Power, empowerment and professional practice*. Open WorldCat.
- Leibovitz, Z., Daniel-Spiegel, E., Malinger, G., Haratz, K., Tamarkin, M., Gindes, L., Schreiber, L., Ben-Sira, L., Lev, D., Shapiro, I., Bakry, H., Weizman, B., Zreik, A., Egenburg, S., Arad, A., Tepper, R., Kidron, D., & Lerman-Sagie, T. (2016). Prediction of microcephaly at birth using three reference ranges for fetal head circumference: Can we improve prenatal diagnosis? *Ultrasound in Obstetrics & Gynecology*, 47(5), 586–592. <https://doi.org/10.1002/uog.15801>
- López, I. O. (2008). *Matters of choice: Puerto Rican women's struggle for reproductive freedom*. Rutgers University Press.
- Löwy, I. (2017). Leaking containers: Success and failure in controlling the mosquito aedes aegypti in Brazil. *American Journal of Public Health*, 107(4), 517–524. <https://doi.org/10.2105/AJPH.2017.303652>
- Mansuy, J. M., Dutertre, M., Mengelle, C., Fourcade, C., Marchou, B., Delobel, P., Izopet, J., & Martin-Blondel, G. (2016). Zika virus: High infectious viral load in semen, a new sexually transmitted pathogen? *The Lancet Infectious Diseases*, 16(4), 405. [https://doi.org/10.1016/S1473-3099\(16\)00138-9](https://doi.org/10.1016/S1473-3099(16)00138-9)
- Marteletto, L. J., Weitzman, A., Zanatta Coutinho, R., & Valonguiero Alves, S. (2017). Women's reproductive intentions and behaviors during the Zika epidemic in Brazil. *Population and Development Review*, 43(2), 199–227. <https://doi.org/10.1111/padr.12074>
- Maxwell, J. A. (2013). In L. Bickman & D. Rog (Eds.), *Qualitative research design: An interactive approach* (pp. 105–115). SAGE Publications, Inc.
- Meaney-Delman, D., Rasmussen, S. A., Staples, J. E., Oduyeb, T., Ellington, S. R., Petersen, E. E., Fischer, M., & Jamieson, D. J. (2016). Zika virus and pregnancy: What obstetric health care providers need to know. *Obstetrics and Gynecology*, 127(4), 642–648. <https://doi.org/10.1097/AOG.0000000000001378>
- Mubyazi, G., Bloch, P., Kamugisha, M., Kitua, A., & Ijumba, J. (2005). Intermittent preventive treatment of malaria during pregnancy: A qualitative study of knowledge, attitudes and practices of district health managers, antenatal care staff

- and pregnant women in Korogwe District, north-eastern Tanzania. *Malaria Journal*, 4(1), 31. <https://doi.org/10.1186/1475-2875-4-31>
- Neely, L. (2016). Facing explosion of Zika in Puerto Rico, protest stops toxic spraying before it starts. *Workers World*. <https://www.workers.org/2016/08/11/facing-explosion-of-zika-in-puerto-rico-protest-stops-toxic-spraying-before-it-starts/>.
- Pan American Health Organization (PAHO) & World Health Organization (WHO). (2018). *Timeline of emergence of Zika virus in the Americas*. Pan American Health Organization. https://www.paho.org/hq/index.php?option=com_content&view=article&id=11959:timeline-of-emergence-of-zika-virus-in-the-americas&Itemid=41711&lang=en, accessed December 16, 2018
- Perreira, K., Peters, R., Lallemand, N., & Zuckerman, S. (2017). *Puerto Rico health care infrastructure assessment: Site visit report. research report*. Urban Institute. https://www.urban.org/sites/default/files/publication/87011/2001050-puerto-rico-health-care-infratructure-assessment-site-visit-report_1.pdf
- Pfeiffer, J., & Nichter, M., & Critical Anthropology of Global Health Special Interest Group. (2008). What can critical medical anthropology contribute to global health? A health systems perspective. *Medical Anthropology Quarterly*, 22(4), 410–415. <https://doi.org/10.1111/j.1548-1387.2008.00041.x>
- Rallis, S., Skouteris, H., McCabe, M., & Milgrom, J. (2014). The transition to motherhood: Towards a broader understanding of perinatal distress. *Women and Birth*, 27(1), 68–71. <https://doi.org/10.1016/j.wombi.2013.12.004>
- Richardson, S. S., Daniels, C. R., Gillman, M. W., Golden, J., Kukla, R., Kuzawa, C., & Rich-Edwards, J. (2014). Society: Don't blame the mothers. *Nature*, 512(7513), 131–132. <https://doi.org/10.1038/512131a>
- Rodríguez-Díaz, C. E., Garriga-López, A., Malavé-Rivera, S. M., & Vargas-Molina, R. L. (2017). Zika virus epidemic in Puerto Rico: Health justice too long delayed. *International Journal of Infectious Diseases*, 65(1), 144–147. <https://doi.org/10.1016/j.ijid.2017.07.017>
- Schoen, J. (2005). *Choice & coercion: Birth control, sterilization, and abortion in public health and welfare*. University of North Carolina Press.
- Shigenobu, T. (2007). "Evaluation and usability of back translation for intercultural communication." In *Usability and Internationalization: Second International Conference on Usability and Internationalization*, Nuray Aykin, ed. *UI-HCII 2007, Held as Part of HCI International 2007, Beijing, China, July 22-27, 2007: Proceedings. Lecture Notes in Computer Science*, 4559–4560 (pp. 259–265). Berlin; New York, Springer.
- Singer, M. (1995). Beyond the ivory tower: Critical praxis in medical anthropology. *Medical Anthropology Quarterly*, 9(1), 80–106. <https://doi.org/10.1525/maq.1995.9.1.02a00060>
- Tepper, N. K., Goldberg, H. I., Vargas Bernal, M. I., Rivera, B., Frey, M. T., Renquist, C. M., Bracero, N. J., Dominguez, K. L., Sanchez, R. E., Shapiro-Mendoza, C. K., Rodriguez, B. R. C., Simeone, R. M., Pesik, N. T., Barfield, W. D., Ko, J. Y., Galang, R. R., Perez-Padilla, J., Polen, K. N. D., Honein, M. A., Jamieson, D. J., & Malave, C. (2016). Estimating contraceptive needs and increasing access to contraception in response to the Zika virus disease outbreak — Puerto Rico, 2016. *MMWR. Morbidity and Mortality Weekly Report*, 65(12), 311–314. <https://doi.org/10.15585/mmwr.mm6512e1>
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, 15(3), 398–405. <https://doi.org/10.1111/nhs.12048>
- Weldon, C. T., Riley-Powell, A. R., Aguerre, I. M., Celis Nacimiento, R. A., Morrison, A. C., Oberhelman, R. A., Paz-Soldan, V. A., & Tekola Ayele, F. (2018). "Zika is everywhere": A qualitative exploration of knowledge, attitudes and practices towards Zika virus among women of reproductive age in Iquitos, Peru. Fasil Tekola Ayele, ed. *PLoS Neglected Tropical Diseases*, 12(8), e0006708. <https://doi.org/10.1371/journal.pntd.0006708>
- Winett, L. B., Wulf, A. B., & Wallack, L. (2016). Framing strategies to avoid mother-blame in communicating the origins of chronic disease. *American Journal of Public Health*, 106(8), 1369–1373. <https://doi.org/10.2105/AJPH.2016.303239>