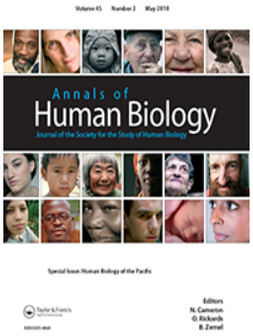

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RESEARCH PAPER

Zika virus in American Samoa: challenges to prevention in the context of health disparities and non-communicable disease

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ABSTRACT

Background: Zika virus (ZIKV) is linked to deleterious foetal and neonate outcomes. Maternal exposure to ZIKV through mosquitoes and sexual fluids creates a public health challenge for communities and policy-makers, which is exacerbated by high levels of chronic non-communicable diseases in American Samoa.

Aim: This study aimed to identify structural barriers to ZIKV prevention in American Samoa and situate them within locally relevant cultural and epidemiological contexts.

Subjects and methods: This study assessed knowledge, attitudes and access to ZIKV prevention among 180 adults in American Samoan public health clinics. It queried knowledge about pre-natal care, protection against mosquitoes and condom use.

Results: Women were most likely to identify pre-natal care as important. The majority of participants were able to identify how to prevent mosquito bites, but may have been unable to follow through due to socioeconomic and infrastructure limitations. Few participants identified condom use as a preventative measure against ZIKV. Prevention misconceptions were most pronounced in women of low socioeconomic status.

Conclusions: These findings reinforce the need for a multi-pronged approach to ZIKV. This study highlights the need for information on culturally specific barriers and recognition of additional challenges associated with dual burden in marginal populations where social inequalities exacerbate health issues.

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Zika virus; pre-natal care; sexual health; dual burden; American Samoa

Introduction

The Zika virus (ZIKV) was declared a global public health emergency by the World Health Organisation (WHO) in February 2016 (Gulland 2016). Despite mild symptoms for most infected people (Chang et al. 2016), ZIKV is linked to a host of deleterious foetal and neonate outcomes among women who become infected while pregnant (de Oliveira Melo et al. 2016). The long-term potential of birth defects associated with this vertical transmission puts ZIKV amongst the most urgent global infectious disease crises to emerge in the 21st century, especially because the largest burden of ZIKV falls on low- and middle-income countries that are concurrently battling long-term consequences of the chronic diseases of globalisation. This paper identifies the structural barriers associated with ZIKV prevention and the disproportionate impact on socioeconomically disadvantaged infants (*pepe*), families (*aigá*) and women (*tinā*) in American Samoa as part of our Pepe, Aigá, and Tinā Health Study (PATHS). In this study, we examined family attitudes towards pre-natal care and accessed knowledge and perceptions surrounding ZIKV prevention.

ZIKV was first isolated in Uganda in 1952 and has appeared around the globe for a half-century (Dick 1952; Diniz 2017), but recent mutations in the virus have expanded transmission routes beyond mosquitoes (*Aedes aegypti*) to include transfer through sexual fluids and vertically between ZIKV-positive mothers and developing foetuses (Petersen et al. 2016). This new form of ZIKV reached epidemic levels in early 2015, primarily in parts of the Pacific Islands and the Americas (Gatherer and Kohl 2016). Although these regions have faced numerous mosquito-borne infectious disease epidemics, ZIKV is the first to be transmitted both through mosquitoes and sexually (Tambo et al. 2016). As such, ZIKV prevention combines challenges associated with other flaviviruses (e.g. yellow fever, dengue, chikungunya) and sexually transmitted infections (e.g. human immunodeficiency virus [HIV], syphilis, chlamydia) (Tambo et al. 2016).

ZIKV prevention is an urgent concern, because the virus's most profound effects are intergenerational. Infants exposed to ZIKV during gestation are at risk of congenital Zika syndrome, which involves increased risks of miscarriages, stillbirths, hearing and vision deficits, seizures, permanent foetal brain damage (including microcephaly), lifelong impairments, developmental delays, and early death (Alvarado and Schwartz 2017; Centers for Disease Control and Prevention (CDC) 2016). If children with congenital Zika syndrome survive, they can face lifelong challenges that may require specialised education, healthcare and therapies.

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ZIKV would be a serious public health challenge if it existed in isolation. In American Samoa, this epidemic is complicated by the high prevalence of non-communicable diseases (NCDs) with their own sequelae for healthy pregnancies and infants. A population-based study in 2014 detected overweight and obesity prevalence upward of 90% among women and men and an overall type 2 diabetes prevalence of 47% (WHO 2014). NCDs are at epidemic proportions in American Samoa, but sustained educational and financial response is difficult precisely because the public health system is concurrently dealing with other emergencies, such as the ZIKV outbreak.

Cultural, epidemiological and infrastructural concerns in America Samoa make addressing this dual burden particularly challenging. American Samoa is an unorganised and unincorporated territory comprising the five populated islands over which the US Government exerts transient authority. In 2005, 53% of families fell below the US poverty line (American Samoa Department of Commerce 2007). Local governance retains a strong emphasis on social and gender-based hierarchies, exemplified by its system of village-level, mostly-male chiefs (*matai*). This traditional system of governance integrated with missionary ideologies that began transforming the island in the 1820s (Holme and Holme 1992). Although Samoans established an active trade system throughout the Pacific prior to Western contact, outside militarisation and missionisation resulted in connections to a global trade economy that left the Islands dependent on the US, but still isolated (Kennedy 2009).

American Samoa's geographic and cultural distance and lack of full representation in Congress means that the territory's public health concerns are often marginalised, putting its people at risk for a range of NCDs and biobehavioural issues (McGarvey 2001). American Samoans receive reduced-cost healthcare through government-funded programmes (Medicaid, WIC, etc.) and rarely have outside insurance. Although there are no co-payments or deductibles under the American Samoan Medicaid programme, the hospital charges fees for visits and tests (Centers for Medicare & Medicaid Services 2018). Women receiving early pre-natal care can qualify for reduced-cost care, but are required to pay ~$70 USD for tests run during their first pre-natal care appointments (Howells 2013; Hawley et al. 2014). This represents nearly 11% of an average monthly salary in the territory and can result in a barrier to care (Central Intelligence Agency 2013–14).

Because there is no cure for ZIKV, prevention and education for mothers is critical and occurs primarily during pre-natal care (PNC). In American Samoa, women receive the majority of their preventative ZIKV education and ZIKV prevention kits during their first PNC appointments. These kits include two 6 oz bottles of mosquito repellent, permethrin for two outfits, larvacidal dunks, a bed net and seven condoms. This focused preventative education makes PNC especially critical for ZIKV prevention.

The American Samoan healthcare system has dedicated medical professionals to administer pre-natal care and support staff, yet is officially a 'health professional shortage area' in all aspects of primary, medical, dental and mental health care (U.S. Department of Health & Human Services 2017). Biomedical facilities for all of American Samoa are limited to a single public hospital (LBJ Tropical Medical Center), five Department of Health clinics (including one in the Manu'a islands) and Emergency Medical Services, all funded primarily by the US Government. Short-term public health programmes originating off-island are common, but have historically been effective only after obtaining the support of local medical officials, chiefs and churches (e.g. DePue et al. 2010). For instance, a 2016 effort by the CDC to distribute 5000 condoms as part of the ZIKV prevention initiative was met with resistance by Samoan leaders, who worried free access to contraception would encourage pre-marital sex among youth.

ZIKV prevention recommendations—getting early preventative education through pre-natal care, avoiding mosquitoes and practicing safe sex—were created in response to evidence-based science (CDC 2016; Brownson et al. 2017) but may be challenging to follow in communities where access to care, information and infrastructure are limited (Howells and Pieters, 2018). The CDC's recommendations often assume a greater degree of individual access to preventative measures and control over reproductive care than many women have.

In this paper, we test this proposition by evaluating local perceptions and knowledge of ZIKV prevention and access to preventative resources among healthcare professionals and patients. We use these perceptions to explore resource tensions experienced by American Samoan communities that, like many others, are facing the dual burden of infectious and chronic diseases. Furthermore, we investigate potential gender differences in healthcare knowledge, education and behaviours. In so doing, we underscore the fact that access and utilisation of preventative health in American Samoa are culturally, socioeconomically and structurally shaped. We highlight barriers that may challenge the success of public health programmes within this community and that exasperate health issues in this dually burdened population.

Methods

We assessed the knowledge, attitudes and access to ZIKV prevention in 180 adult women and men in American Samoa Department of Health (ASDOH) clinics. Our main clinical collaborators were members of the Zika Task Force convened by ASDOH, which consisted of ASDOH medical staff, rotating members of a CDC ZIKV response team, American Samoa Emergency Medical Services and other supportive individuals and agencies. In 2017, we returned to American Samoa to discuss and clarify our findings with those involved in the ZIKV response. This study is part of an on-going 7-year study addressing maternal and child health in American Samoa, led by the first author.

The Institutional Review Boards of the University of North Carolina Wilmington and the Government of American Samoa pre-approved all research protocols.

Data collection

From July–August 2016, we developed and administered the 75-item PATHS survey to adults in ASDOH clinics. The PATHS survey was developed in conjunction with medical staff at ASDOH. This survey assessed participant knowledge, attitudes and access to three realms of ZIKV prevention—pre-natal care, mosquitoes and condoms. Each item could be answered on a 4-item scale ('true', 'mostly true', 'mostly false' or 'false').

We assessed mosquito exposure through queries about household and workplace, such as whether people rent or own, have air conditioning or intact screens, sleep under a mosquito net, use insect repellent and if their primary means of travel exposes them to mosquitoes. We developed a 15-item Zika Knowledge Scale with sub-scales for Mosquito Prevention Knowledge (eight items) and Sexual Transmission-Prevention Knowledge (three items) using the CDC factsheet on ZIKV (CDC 2016). We modified items from the Contraceptive Attitude Scale (Black 2013) to assess attitudes towards condoms. Direct discussion of sexual behaviour is impolite in American Samoa, so we worked directly with Samoan medical professionals to ensure the use of culturally appropriate language. We developed a 12-item Pre-natal Care Scale based on the lead author's ethnographic research (Howells 2013) and focused on the perceived importance of access to care in relation to social status. Access to care refers to timing and frequency of pre-natal care. ZIKV prevention items assessed awareness of transmission mechanisms and danger for mothers and foetuses.

We established face validity for the questionnaires by working with bilingual ASDOH health professionals to ensure items were understandable for respondents, regardless of educational background. The survey was translated into Samoan by the Samoan Studies Institute at the American Samoa Community College and back-translated by these health professionals to ensure meaning was consistent. The final survey included each question in Samoan and English. Scales and sub-scales assessed complementary attitudes and knowledge, and a high degree of convergence was expected. Correlations among these scales were significant but moderate in strength for Zika Prevention Knowledge and Pre-natal Care items ($r = 0.303$, $p < 0.01$), Mosquito Prevention Knowledge and Contraceptive Attitude items ($r = 0.16$, $p = 0.05$), Mosquito Prevention Knowledge and Pre-natal Care items ($r = 0.211$, $p = 0.01$) and Sexual Transmission-Prevention and Contraceptive Attitude items ($r = -0.228$, $p = 0.004$). Consistent with this moderate correlation, the Cronbach's alpha reliability coefficients for the Zika Knowledge Scale (0.68) and Mosquito Prevention Knowledge and Sexual Transmission-Prevention Knowledge sub-scales (0.47, and 0.25, respectively) were acceptable for the first use of a self-developed scale, although relatively low for the sub-scales (Nunnally and Bernstein 1994). Similarly, the coefficients (0.66) for the Contraceptive Attitude and Prenatal Care items (0.65) were also acceptable.

We began administering this survey in July 2016 in the ASDOH Fagaalu Physical Exam Clinic, Tafuna Pre-natal and Well-Baby Clinics and Amouli Pre-natal Clinic. Participants were approached in the waiting room by a team member, who introduced the study. Those who consented to participate were given a paper and pencil questionnaire on a clipboard to complete while waiting for their appointment in the public waiting room. Approximately 215 people were approached and 193 began the survey (~90% response rate). We excluded 13 participants who only completed demographic information. All participants were of Samoan descent and at least 18 years old. The final sample for analysis was 180 adults (68% women), aged 18–73 (mean ± SD $= 32.5 \pm 11.31$). We had more women than men, because men rarely attend pre-natal care visits and women were more likely to take their children to well-baby visits. Participants were from 38 different villages (51%) in American Samoa.

Throughout the course of quantitative data collection, we conducted open-ended interviews with medical professionals and Zika Task Force members including ASDOH medical staff and American Samoa Emergency Medical Services. We were also involved in weekly Zika Task Force and ASDOH nursing meetings. Participant-observation from the first author's longitudinal study provides additional context on which we draw in the discussion to interpret the quantitative results (Howells 2013).

Analysis

Surveys were coded and entered into SPSS Statistics software (Version 24, IBM, Corp., Armonk, NY). We performed univariate and bivariate statistical analyses, as well as linear regressions, to identify significant predictors of knowledge and attitudes about ZIKV prevention. The Zika Knowledge Scale items were collapsed into dichotomised true–false responses. Items that assessed factual information (e.g. '*A vaccine exists for Zika*') were scored as correct/incorrect and correct answers summed. Pre-natal and condom use items were summed separately to create variables for Condom Use (8-items) and Pre-natal Care (12-items), respectively. We checked data for outliers and violations of the assumptions of linearity and homoscedasticity and used independent samples *t*-tests to determine if differences in Samoan culture would be reflected in attitudes and knowledge. We used bivariate correlations to examine associations of scales and sub-scales with demographic and household and workplace factors related to mosquito exposure. Because of convergence among the scales used, we conducted principle components analysis on the combined 35-item Zika Knowledge, Pre-natal Care and Condom Use scales using Varimax rotation to determine latent factors for use in later regression analysis. A Kaiser-Meyer-Oklin value of 0.574 and Bartlett's Test of Sphericity value <0.001 indicated suitability of data for factor analysis.

A scree plot was used to determine factors and factor scores were calculated for each using the regression method. Finally, we conducted multiple linear regression analysis on factor scores. We standardised all variables and used the backward elimination method to develop predictive models that determined influences of demographic, household and

workplace differences on factor scores. To reduce the chance of Type I error that can be associated with this approach, we used a Bonferroni correction of $p < 0.025$ for regression analysis.

Results

Slightly more than half our sample (51.1%) was married. Among women, 45% were the wives or daughters of chiefs, while 40% of the men were titled. Titled people and those who lived with them were more likely to be employed ($r = 0.207$, $p = 0.048$), as were people with more education ($r = 0.172$, $p = 0.027$). In our sample, the average number of years of schooling was 12.4 (±1.88), with most completing high school (the equivalent of secondary school in the UK), with a range of 2–16 years of school completed. Samoans live in relatively large households (mean ± SD =6.8 ± 3.78, min–max =1–24). These households were primarily comprised of adults (4.0 ± 2.55, 1–20) rather than children (2.9 ± 2.39, 0–16). People with larger household sizes were more likely to own their homes ($r = 0.195$, $p = 0.013$).

We asked participants about their mosquito exposure in the home and workplace. As Table 1 outlines, the majority of our participants owned their home and did not have air conditioning, but did have screens. Screens were generally intact and people rarely used mosquito bed nets or insect repellent. The employment rate was relatively low, but those employed generally had air conditioning and screens in their workplaces. However, bivariate analysis indicated significant positive correlations between insect repellent usage and sleeping under a bed net ($r = 0.280$, $p < 0.001$). There were significant negative correlations between having home air conditioning and having ripped screens or doors ($r = -0.186$, $p = 0.045$) and between insect repellent usage and having ripped screens ($r = -0.199$, $p = 0.031$). We compared women and men using independent samples *t*-tests and found no gender-based differences in these exposure variables.

The Zika Knowledge scale, Mosquito Protection Knowledge and Sexual Transmission-Protection Knowledge sub-scales were scored based on the number of factual items participants answered correctly. We summed Pre-natal Care and Condom Use scales (Table 2). We conducted independent samples *t*-tests by gender and found no differences in these variables. We conducted correlation analyses between these scale scores and demographic, household and workplace factors, but there were no significant associations.

Women and men did differ significantly with regard to individual perception of pre-natal care (PNC), ZIKV prevention and condom use (Table 3). Women were significantly more likely to state that they valued pre-natal care, although they believed pre-natal care was unnecessary if a pregnant woman felt all right. Men were more likely to indicate concern for financial costs surrounding PNC. In addition, men were more likely to think there is a vaccine for ZIKV and that women should limit pregnancies as an effective strategy to avoid ZIKV. Finally, women and men were both averse to condom use and women described sex as less fun with a condom; but effect sizes were not large in either case.

The scree plot derived from the principal components analysis indicated two factors explaining 12.3% and 6.6% of the variance in knowledge and attitudes toward ZIKV, respectively. Table 4 shows items that loaded on each factor. Items loading on factor 1 were largely attitudes or opinions, whereas items loading on factor 2 related mostly to factual knowledge.

Linear regressions using backward elimination were used to assess what variables influenced gender-oriented attitudes and factual knowledge. We elected to use backward elimination because this study was exploratory in nature. Initial predictors included in the model were age, gender (men/women), title status (untitled/titled), marital status (unmarried/married), education (number of years completed), household size, rent/own, home air conditioning (don't have/have), home screens (don't have/have), ripped screens (have/don't have), use of bed nets (don't use/use), mosquito spray frequency, workplace air conditioning (don't have/have), workplace screens (don't have/have) and travel mode (walk/bus/car). All categorical referents ranged from negative to positive in value or social importance as indicated. Regression on attitudes and opinions (factor 1) was predicted by gender and a number of household factors relevant to mosquito avoidance (Table 5)—i.e. women who live in rented homes that lack air conditioning or window screens had more positive attitudes or opinions toward maternal health. If they had screens, they tended to be intact. Bed net usage was low, but insect repellent use was relatively high.

Factual knowledge (factor 2) was predicted mostly by demographic and workplace factors (Table 5). Younger, married, relatively educated women with jobs outside the home

Table 1. Mosquito exposure-related household and workplace factors. Values are expressed as percentages.

	Overall	Women	Men
Own home	82.0	82.4	88.2
Air conditioning in home	37.1	36.7	41.5
Screens in home windows and doors	86.5	86.3	85.4
Rips in screens	21.8	25.0	11.1
Sleep under mosquito net	26.7	29.2	17.9
Use insect repellent at least once/day	35.5	35.6	21.4
Employed	61.0	58.3	67.5
Air conditioning in workplace	51.1	49.2	60.5
Screens in workplace windows and doors	74.7	70.1	88.0

Table 2. Comparison of mean ± SD (min–max) for Pre-natal Care, the ZIKV Knowledge and Mosquito Protection Knowledge, Sexual Transmission-Prevention Knowledge and Condom Use scales.

	Overall	Women	Men
Pre-natal Care	8.44 ± 1.958 (0–12)	8.54 ± 1.836 (2–10)	8.38 ± 1.954 (0–11)
Zika Prevention Knowledge	8.91 ± 2.720 (0–15)	9.26 ± 2.284 (1–14)	8.43 ± 3.314 (1–14)
Mosquito Protection Knowledge	5.47 ± 1.597 (0–8)	5.53 ± 1.364 (1–7)	5.61 ± 1.759 (1–7)
Sexual Transmission-Prevention Knowledge	1.72 ± 0.884 (0–3)	1.69 ± 0.879 (0–3)	1.79 ± 0.935 (0–3)
Condom Use	4.16 ± 1.47 (0–8)	4.11 ± 1.448 (0–8)	4.23 ± 1.625 (0–8)

Table 3. Significant differences ($p < 0.05$) between women and men regarding knowledge and attitudes about pre-natal care, ZIKV prevention and condom use. Values are presented as percentages, excluding missing data.

	Women		Men	
	True (%)	False (%)	True (%)	False (%)
It is critical for all mothers to have pre-natal care	90.2	6.6	73.3	0
Pre-natal care is critical for all babies	89.3	4.1	74.4	0
Pre-natal care is expensive	39.3	50.8	48.8	23.3
Individual women (not family) should pay the cost of pre-natal care	41.0	53.3	48.8	23.3
It is important for men to know about pre-natal care	87.7	4.9	67.4	0
Adequate pre-natal care saves the family money over time	66.4	24.6	62.8	7.0
As long as a woman feels OK she does not need to get pre-natal care	85.2	10.7	46.5	27.9
A vaccine exists to prevent Zika	59.8	29.5	76.7	11.6
Women should get pregnant when there is Zika[a]	62.3	31.1	27.9	60.5
Avoiding mosquito bites helps prevent Zika	78.7	17.2	86.0	4.7
Mosquito body spray ('Off' with DEET) helps prevent Zika	80.3	13.9	81.4	2.3
Males who use condoms seem manly/masculine	47.5	41.0	23.3	60.5
Sex is fun if a condom is used	31.1	61.5	46.5	41.9

[a]Valence of items has been reversed.

Table 4. Varimax-rotated principal components of ZIKV attitudes and knowledge.

	Factor 1	Factor 2
Married women should get pre-natal care earlier than unmarried women	0.501	0.280
A vaccine exists to prevent Zika	0.558	−0.099
Women should NOT get pregnant until there is no more Zika	0.543	0.219
Mosquitoes that spread Zika mostly bite at night	0.413	−0.043
Condom use does NOT prevent the transmission of Zika sexually	0.437	0.081
Cleaning up bottles and chip bags does NOT reduce Zika	0.459	−0.044
It is wrong to use condoms	0.432	−0.077
Most men talk about condoms with their friends	0.522	0.006
Males who use condoms seem LESS manly/masculine	0.576	−0.029
Sex is fun if a condom is used	0.454	0.070
Most men do NOT believe that condoms actually prevent pregnancy/sexually transmitted infections	0.422	−0.057
Females who use condoms are promiscuous	0.562	0.072
Adequate pre-natal care saves the family money over time	0.134	0.598
Avoiding mosquito bites helps prevent Zika	−0.099	0.628
Zika is transmitted sexually and through mosquitoes	−0.004	0.547
Mosquito body spray ('Off' with DEET) helps prevent Zika	−0.059	0.545

Valence of categorical referents are negative to positive for values and according to social importance (e.g. rent–own, wrong–right).

Table 5. Linear regression on factors 1 and 2 score derived from Prenatal Care, Zika Prevention Knowledge and Condom Use items.

	Factor 1[a]		Factor 2[b]	
	Standardized ß	*p*	Standardized ß	*p*
Gender (male/female)	1.067	<0.001	0.821	<0.001
Own or rent	−0.182	0.031		
Home air conditioning (no/yes)	−0.798	<0.001		
Home screens (no/yes)	−0.275	0.004		
Ripped home screens (no/yes)	−0.368	0.002		
Bed nets (no/yes)	−0.404	0.001	0.688	0.003
Insect repellent use (frequency)	0.227	0.009		
Age			−0.493	0.021
Marital status (single/married)			0.592	0.016
Education (highest grade)			0.463	0.020
Workplace air conditioning (no/yes)			0.783	0.001
Travel mode (walk/bus/car)			1.231	<0.001

Valence of categorical referents are negative to positive for values and according to social importance (e.g. rent–own, wrong–right).
[a]$F_{8,9} = 27.637$, $p < 0.001$, Adjusted $r^2 = 0.926$.
[b]$F_{7,10} = 7.460$, $p = 0.003$, Adjusted $r^2 = 0.727$.

scored better in factual knowledge related to ZIKV prevention and avoidance and also tended to use bed nets for mosquito avoidance.

Gender and home air conditioning had the strongest associations with attitudes and opinions (factor 1) and gender and workplace air conditioning with factual knowledge (factor 2). As seen in Figure 1, women who lacked home air conditioning had higher factor 1 scores. Many of the factor 1 items suggested Samoans hold some misconceptions about ZIKV and condom use in particular, so these results may indicate that attitudes and opinions are most consistent among women without air conditioning. We expect that the women who do not have air conditioning are likely to be less affluent, so higher levels of misconception among this group may be a product of low socioeconomic status. Figure 2 shows that women with workplace air conditioning had a slightly higher mean factor 2 score, which is related to factual knowledge. In American Samoa, women who work outside the

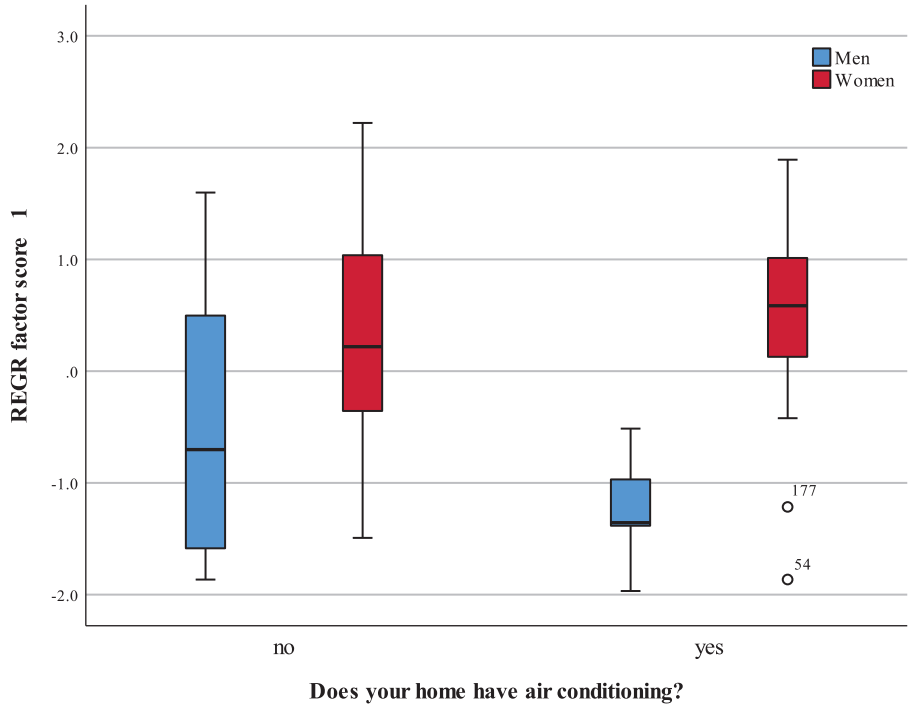

Figure 1. Box plot of factor 1 scores (loadings related primarily to opinions and attitudes about ZIKV prevention) relative to the presence of home air conditioning by gender. Home air conditioning and gender explain the most variation in factor 1 in regression modelling.

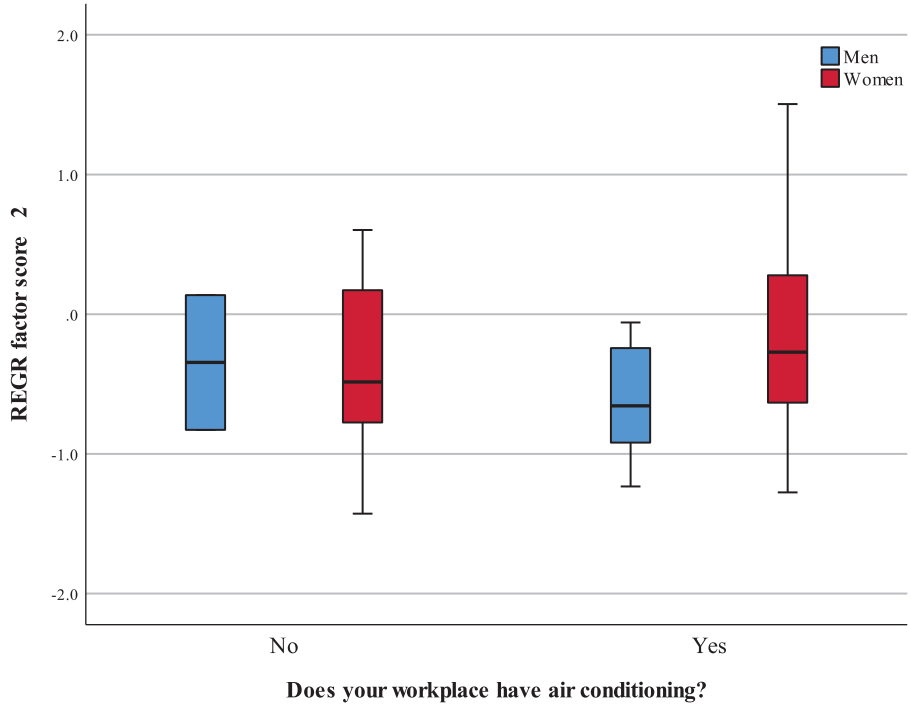

Figure 2. Box plot of factor 2 scores (loadings related primarily to factual knowledge about ZIKV prevention) relative to the presence of workplace air conditioning by gender. Workplace air conditioning and gender explain the most variation in factor 2 in regression modelling.

home tend to be better educated, and working somewhere with air conditioning suggests a relatively higher status job.

Discussion

This exploratory study focused on understanding the barriers facing ZIKV response in American Samoa. ZIKV has the potential to dramatically alter the survivability and development of foetuses and children and has long-term ramifications for community health (CDC 2017a, 2017b, 2017c). These challenges are magnified in American Samoa, where community health is burdened by high rates of NCDs and strained healthcare resources.

This paper aimed to portray a local landscape of knowledge, resources and challenges around the emergent ZIKV epidemic in American Samoa in the context of this dual

burden of disease. Our findings fell into two main categories—perceptions about pre-natal care and familiarity and acceptability of ZIKV prevention measures, which we address below.

Perceptions around pre-natal care

Attitudes towards pre-natal care (PNC) are of critical importance to ZIKV prevention and overall health education. The CDC identifies PNC as a key opportunity to reach the most vulnerable population with ZIKV preventative education (CDC 2016). Samoans in this study were aware that ZIKV is a greater threat for pregnant mothers and that these women especially need to comply with prevention recommendations. At a basic level, however, PNC can be challenging to access in American Samoa. A previous study found that, from 2001–2008, 85.4% of women received inadequate PNC, based on the Adequacy of Pre-natal Care Utilisation Index (Kotelchuck 1994; Hawley et al. 2014). Barriers to care include unemployment, parental under-employment and limited transportation (Hawley et al. 2014).

In addition to the financial and logistic barriers to PNC, our study identified belief-based barriers to pre-natal care for some women. The majority of our participants (86%) believed that married women deserved PNC earlier than did unwed mothers. This is consistent with our previous research, which indicates maternal marital status affects care, with married women receiving earlier and more frequent care than their unmarried peers and experiencing fewer surgical interventions during delivery (Howells 2013; Howells et al. 2016). Both logistic and belief-based barriers to pre-natal care place unmarried and lower-income women, who are already socially marginalised, at greater risk of ZIKV and its complications, because they delay timing of preventive ZIKV education and access to Zika Prevention Kits. Some women also reported that PNC might be unnecessary if a woman felt alright during pregnancy. While women expressed a desire for men to be more involved with pre-natal care, men reported being more focused on the associated financial burdens. This is consistent with informant reports regarding explicit and implicit gender roles in Samoan society, where men largely maintain control of household finances (Howells 2013).

Familiarity and acceptability of ZIKV prevention measures

As noted, ZIKV prevention is challenging because the virus can be transmitted through mosquitoes and sexual fluids. Our study indicated that people had significantly more knowledge about the mosquito transmission of ZIKV than the sexual route. Of eight mosquito-related items in our survey, 64% of women and men answered at least six items correctly. This accuracy likely reflects the success of on-going public health campaigns associated with mosquito-borne pathogens like dengue and chikungunya, which helped educate the community about the prevention of mosquito-borne diseases prior to the arrival of ZIKV (Horwood et al. 2013; Cao-Lormeau and Musso 2014; Roth et al. 2014).

Knowledge of prevention does not necessarily translate into preventative action, as our study results underscore. Cultural, structural and socioeconomic constraints made it challenging for most participants to act on public health recommendations aimed at reducing mosquito breeding grounds and decreasing mosquito exposure. For instance, we found that people frequently misidentified small litter (including potato chip bags and empty soda cans) as primary breeding zones for mosquitoes, rather than larger water receptacles like old appliances, tires and buckets, which local entomologists indicate are the major mosquito breeding grounds. Samoans explained that these large items are expensive to remove and that there are limited areas on-island to dispose of them. As a result, they sit near homes and rust, providing large-scale breeding opportunities for mosquitoes.

Moreover, preventative measures for ZIKV, such as limiting time outdoors and keeping skin covered, can directly exacerbate chronic disease risk because they increase discomfort and reduce options for physical activity. The most common forms of exercise are outdoor activities, including walking, outdoor volleyball, Zumba (in gymnasiums with open doors for air) and Tae Bo (taught in an open parking lot). Nearly all respondents knew that long-sleeved shirts and pants help protect against ZIKV, yet short-sleeves, shorts, dresses and *lavalavas* (fabric wrapped around the waist) are ubiquitous in the tropical humidity, particularly when exercising. As a result, people receive conflicting health advice regarding mosquito avoidance for ZIKV prevention and exercise for chronic disease prevention.

Other recommendations meant to reduce exposure to mosquitoes—e.g. air conditioning and window screens, bed nets, reduced time outdoors, long clothing and insect repellent—are difficult to follow, because people simply lack access to many of these resources. The majority (65%) of our study participants did not have air conditioning and 36% with window screens reported that they were missing or damaged. Participants frequently asked if there was a government programme that fixes or replaces screens to prevent exposure to ZIKV (there was not). Insect repellent is also expensive and not frequently used—only 13% of our sample used it more than once a day, while 49% of participants reported only using it once a month. Only 27% of our study sample reported sleeping under bed nets. Twenty-four per cent reported walking to work as their primary form of transportation, while 37% relied on open-air buses and cars. Utilising buses can increase exposure to mosquitoes because of unpredictable schedules and long waits outside. Informants reported that the constant presence of mosquitoes makes them seem less threatening. Samoans have been around mosquitoes for centuries, they indicated, so they are not 'bothered' by them like *palagi* (white people).

In addition to preventing exposure to mosquitoes, the CDC recommends using condoms during sexual intercourse in ZIKV-positive areas. Although the sexual transmission route wasn't confirmed until June 2016, it was suspected much earlier and incorporated sporadically into public health

messaging in American Samoa (D'Ortenzio et al. 2016). However, less than half of our participants (47%) were aware that condoms could prevent sexual ZIKV transmission. It is likely that taboos surrounding condom use and discussions of condoms as 'impolite' are responsible for the lower knowledge of ZIKV sexual transmission vs mosquito transmission. Samoan leaders indicated concern that the inclusion of condoms in ZIKV public health messaging would 'send the wrong message' to youth. As a result, prominent outreach campaigns in 2016 and 2017 that included billboard, radio and newspaper ads excluded mention of condoms. However electronic CDC signage in the departure area of the airport did make indirect reference to ZIKV prevention through condom use.

Challenges surrounding condoms may be related to strong cultural stigmas associated with pre-marital sex in this community. In a small population where anonymity or privacy are nearly impossible and maintaining family reputation is paramount, being seen purchasing or even taking condoms from the family planning clinic on-island can be socially costly. According to our informants, condoms were viewed almost exclusively as a way to prevent unwanted pregnancies (rather than sexually transmitted infections) and were associated primarily with stigmatized extramarital or pre-marital sex. Sexual health education is prohibited in public schools in American Samoa and the majority of sexually active teens in this community report not using any form of contraception (Brener et al. 2011; CDC 2011; Dateline Pacific 2014). Informants indicated that it was better to risk unprotected sex than get caught trying to obtain condoms.

These attitudes are consistent with other studies in the Pacific region. Communities of Tonga and Vanuatu indicate that societal and religious disapproval around sexual activity did not decrease the amount young people engaged in sexual behaviour. Although condoms were available, they are rarely used and sex engaged in covertly, increasing risk (McMillan and Worth 2011). Insights on condom-use implementation from other regions indicate that such programmes do not work if they are not seen as culturally relevant (McMillan and Worth 2011). Similar attitudes in American Samoa may increase the threat of ZIKV.

Moreover, because marriage is associated with socially-sanctioned sex for reproductive purposes, it was considered illogical and nonsensical to use condoms during pregnancy, even though this is recommended for ZIKV prevention. One participant referred to wearing a condom while pregnant as 'closing the gate after the horse got out'. In addition, 31% of women and 61% of men thought that women should wait to get pregnant until the risk of ZIKV has passed. However, barriers to pregnancy prevention would make it challenging for women to fulfil these expectations.

ZIKV in context: future directions and possibilities

External healthcare teams have been a critical aspect of the ZIKV response in American Samoa. However, they can improve their effectiveness by identifying barriers to prevention, developing culturally sensitive materials and strategies and improving communication with local healthcare workers. Although ZIKV prevention strategies were developed with evidence-based science, they assume members of the community have equal access to the financial, social and educational resources necessary for implementation. This can result in assumptions of greater degrees of individual access to preventative measures and control over family planning than is realistic within the community.

External healthcare teams can also improve their success by seriously engaging and truly collaborating with local professionals. For instance, accessing barriers to prevention, including pre-natal care, mosquitoes and access to condoms can identify members of the community at greatest risk. For instance, this could involve collaboratively developing a brief assessment of potential culturally appropriate condom distribution plans with public health officials (e.g. asking about acceptable locations to leave condoms). One Samoan Nurse Practitioner suggested compensating specific employees in pre-natal clinics for maintaining a container of condoms in the restrooms and including culturally appropriate instructions. This would follow similar public health efforts instigated by the Ministry of Health in the country of Samoa and help reach individuals with a risk of ZIKV.

Attention to local modes of communication is especially important for any internationally conceived public health intervention (Leslie 2002). Most Samoans are bilingual in English and Samoan, but it is rare for healthcare materials generated outside the Islands to be translated into the Samoan language. However, including text in Samoan and English, as well as graphic depictions of Pacific Island people, can make ZIKV educational materials more accessible to all villagers, regardless of literacy, and convey cultural respect. Furthermore, producing such materials with engagement and permission of local leaders could provide support for these intervention programmes.

Medical anthropologists have long suggested that involvement of local officials or cultural brokers increases outside health programme effectiveness (Pfeiffer and Nichter 2008). However, locating such individuals can be a limiting factor in global health interventions. In American Samoa there are numerous cultural experts who publish academic articles or provide white papers outlining basic features of cultural context for international public health workers. Moreover, medical anthropologists have developed Rapid Anthropological Assessment Procedures as part of global health programmes to build cultural competency when time and resources are limited (Scrimshaw and Gleason 1992). Although cultural competency training requires some additional investment in programme development, this is a cost-effective measure to help increase success and reduce losses of time, money and morale associated with non-culturally sound implementation.

Limitations

Our goal in this study has been to explore the diverse challenges facing ZIKV prevention in American Samoa. Accordingly, we developed the PATHS questionnaire to probe the knowledge and attitudes of Samoans surrounding

this disease. We administered the questionnaires in the waiting rooms of the clinics after individuals checked in for their appointments. We asked participants to complete the questionnaires independently, which may have resulted in incomplete data. This decision was made to ensure we received a large enough sample for analysis with limited participant burden and, thus, minimum research fatigue (Clark 2008). In addition, some participants were observed asking questions or pointing out questions they found humorous to their companions. It is possible that the presence of their companions may have impacted their answers, but we were unable to control for potential modification of responses associated with the presence of partners, family members or friends in the clinic. Finally, we were not able to address the impact of power differentials on women's access to condoms.

Conclusions

The re-emergence of ZIKV in American Samoa further complicates the epidemiological landscape. In this paper, we addressed the obstacles that may prevent prevention of ZIKV, that include high poverty levels, limited healthcare access and infrastructure, financial barriers to preventative measures and social norms surrounding condom access and use.

In part because of the urgency surrounding infection, ZIKV response has focused on biomedical causes, with little awareness extended to critical sociocultural factors that influence perceptions of ZIKV and its associated prevention and treatment. However, cultural misunderstandings may compromise efforts to fight ZIKV, as in other urgent infectious disease outbreaks (Hewlett and Amola 2003). The high levels of chronic NCDs in American Samoa create financial and personal problems for the territory that are further strained in infectious disease outbreaks.

One of the many challenges of ZIKV is its dual routes of transmission: sexually and through mosquitoes. Although ZIKV preventive education focusing on mosquito exposure was more common, American Samoans have found it virtually impossible to follow due to infrastructure limitations. We found that barriers to early pre-natal care may delay ZIKV-related education and access to preventative measures. Finally, American Samoan women may be particularly susceptible to sexually-transmitted ZIKV because of limited sex education in the territory, local taboos around condom use and lack of public discourse about the sexual transmission of ZIKV (with a concomitant emphasis only on the mosquito-borne route of transmission).

This paper sought to contextualise findings within larger observations about American Samoa's epidemiological and cultural backgrounds. Addressing the unique features of ZIKV transmission is particularly complex in this setting, where NCD challenges are acute and public health funding more limited than on the mainland US. Furthermore, public health programmes developed in academic settings or for other countries may be ineffective when there are barriers to accessing care, shortages in prevention implementation or cultural or language barriers (Madon et al. 2007).

While medical anthropologists have been advocating for the integration of culturally sensitive approaches in public health since the 1950s (e.g. Paul 1955), the ZIKV case in American Samoa demonstrates that this is still a pressing issue. This integration is especially important for addressing ZIKV, a time-sensitive emerging infection with a complex aetiology and transmission requiring rapid, multi-pronged interventions.

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