

Knowledge of Sexual Transmission of Zika Virus Among Women Who Are Pregnant or Intend to Become Pregnant, Arizona, 2017

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Abstract

Objectives: Levels of knowledge about the sexual transmission of Zika virus are consistently low in populations at risk of a mosquito-borne outbreak, including among women of childbearing age and women who are pregnant or intend to become pregnant. We investigated the effectiveness of sources of public health messaging about sexual transmission to women who are pregnant or intend to become pregnant in Arizona.

Methods: In 2017, we conducted an Arizona-statewide survey 15 months after the initial release of US guidelines on sexual transmission of Zika virus. We used Poisson regression, adjusting for demographic factors, to estimate the likelihood among women who were pregnant or intended to become pregnant of knowing that Zika virus is sexually transmitted relative to other women of childbearing age. We used multinomial logistic regression models to explore associations with most used health information sources, either in person (eg, medical providers) or online (eg, Facebook), categorized by extent of dependability.

Results: Women who were pregnant or intended to become pregnant had similarly poor knowledge of the sexual transmission of Zika virus as compared with other women of childbearing age (adjusted prevalence ratio = 1.14 [95% CI, 0.83–1.55]). Only about one-third of all respondents reported knowledge of sexual transmission. Reliance on high- vs low-dependability information sources, whether in person or online, did not predict the extent of Zika virus knowledge among women who were pregnant or intended to become pregnant.

Conclusion: As late as the second year of local Zika virus transmission in the United States, in 2017, women in Arizona were not receiving sufficient information about sexual transmission, even though it was available. To prepare for possible future outbreaks, research should explore which aspects of Zika information campaigns were ineffective or inefficient.

Keywords

health information sourcing preferences, Zika virus, sexual transmission of Zika virus, pregnancy

Levels of knowledge about the sexual transmission of Zika virus (ZIKV) are low,^{1,2} even among women who are pregnant or intend to become pregnant. ZIKV is associated with congenital birth defects including microcephaly,³ hearing and vision loss,⁴ and other developmental delays if women are infected during (or before) pregnancy.⁵ Despite low-to-moderate awareness of how to avoid infection through sex,^{6,7} women who are pregnant or intend to become pregnant report high levels of concern about ZIKV⁸ and lack of information from physicians or trusted sources.^{9,10} Few studies have examined the dissemination of messaging about the prevention of sexually transmitted ZIKV

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infection. Understanding factors associated with the awareness of this mode of transmission while the epidemic was at its peak is a critical first step toward developing programming for women who are pregnant or intend to become pregnant.

From the outset of the 2015-2016 ZIKV epidemic in the Americas, mosquito-borne transmission was the dominant focus. Information on this mode of transmission was conveyed effectively by public health agencies and departments, which emphasized vector control as a prevention strategy.^{11,12} However, the evidence of sexual transmission grew during the first few months of the outbreak in Brazil.¹³ The risk of sexual transmission is higher among women who are pregnant or intend to become pregnant than among women who do not wish to become pregnant, because the former are less motivated to use condoms.¹⁴ For women who are pregnant or intend to become pregnant, mosquito-avoidance behaviors are insufficient to prevent ZIKV if they are still susceptible to transmission from a male sexual partner, even if he is asymptomatic.¹⁵

Effective strategies to communicate the risk of sexual transmission to all women of childbearing age, especially women who are pregnant or intend to become pregnant but also women who may have an unintended pregnancy,¹⁶ are needed wherever a mosquito-borne outbreak occurs or where women's partners travel or work in areas with mosquito-borne transmission. State and local health departments play a critical role in disseminating ZIKV educational messaging to women of childbearing age, including through support to primary care and prenatal care providers and through information and awareness campaigns. Access to health information of variable dependability via the internet is a problem for public health communication because true-vs-false information is not necessarily distinguishable to consumers.^{17,18} Furthermore, online campaigns implemented by public health departments may not be perceived as useful, trustworthy, or accessible to target populations, especially when unregulated health information platforms, such as Wikipedia and social media (eg, Facebook), are readily available.

The objective of our study was to examine the effectiveness of public health messaging in Arizona on the sexual transmission of ZIKV to women who were pregnant or who intended to become pregnant. We additionally explored patterns of health information-seeking behavior that could explain differences in awareness of sexual transmission of ZIKV.

Methods

We collected survey data beginning in May 2017, which was 15 months after the Centers for Disease Control and Prevention (CDC) released preliminary guidelines on sexual transmission of ZIKV in February 2016.¹⁹ Although no cases of locally acquired ZIKV in Arizona are known, the seasonal presence of *Aedes aegypti* mosquitos, the recent binational outbreak of dengue,²⁰ and the ongoing urbanization that is expanding the species' range made Arizona a key area of concern for a

mosquito-driven outbreak beginning in 2015.²¹⁻²³ Arizona borders the Mexican state of Sonora, which has reported ZIKV cases each year from 2015 through 2019, including 349 cases in 2018, but none in 2020.²⁰ The border region is characterized by a large flow of people moving back and forth across the US-Mexico border, making introductions of ZIKV through both sexual and mosquito-borne transmission feasible. Sexual transmission of ZIKV has more of an effect on overall transmission in areas with small populations of *Ae aegypti*, such as in Arizona, than in areas with large populations of these mosquitos; also, in Arizona, vector density is seasonal and depends on the annual monsoon.²⁴ The University of Arizona Institutional Review Board reviewed this project and determined that the research was considered exempt from human subjects research.

Data Source and Study Design

Our study was a secondary analysis of a 2017 survey of Arizona residents; details of the primary data analysis are available elsewhere.²⁵ The 56-question survey included items on demographic characteristics, general knowledge of ZIKV, respondents' primary health concerns, typical sources of health information, and attitudes and practices related to the prevention of mosquito-borne illness (eg, using repellent, emptying standing water). The survey was available in English and Spanish and was conducted by a Qualtrics panel (Qualtrics International) designed for traditional market research. Respondents were randomly selected on the basis of inclusion criteria provided by investigators. Regional targeting prioritized the 2 largest metropolitan counties in Arizona; approximately 20% of respondents were living in rural or semirural counties. Women of childbearing age were defined as women aged 18-49. Using this survey, we assessed knowledge of ZIKV transmission routes, sources where respondents received most of their health information, and the relationship of demographic characteristics to study outcomes.

Measures

The primary outcome was whether respondents reported knowledge of sexual transmission of ZIKV. The survey question asked, "What are other ways Zika virus can be spread besides mosquitoes?" The response options were blood transfusions, eating contaminated food, unprotected sex, drinking contaminated water, or none of the above. Respondents who said they had never heard of ZIKV were categorized as not knowing about sexual transmission.

The primary predictor was whether respondents were pregnant or intended to become pregnant, which was limited to women aged 18-49 who answered yes to the question, "Are you or your partner currently pregnant or planning to become pregnant?" We assumed it was the respondent who was pregnant or intended to carry a pregnancy because we had no information on the sex of respondents' intimate partners. We compared women who were pregnant or intended to become pregnant with other women of childbearing age. Demographic covariates were age,

Box. Categorization criteria for type of health information sources used by respondents to an online survey of Zika virus knowledge, Arizona, 2017

Internet sources

High dependability (Centers for Disease Control and Prevention website, Mayo Clinic website, Arizona Department of Health Services website, official county health website)

- Uses at least 3 of 4 high-dependability sources “often” or “sometimes”
- Uses ≥ 1 of 4 high-dependability sources “sometimes” but all 3 low-dependability sources “never”
- Uses ≥ 1 of 4 high-dependability sources “often” but no more than 1 of 3 low-dependability sources “ever”
- Uses ≥ 2 of 4 high-dependability sources “sometimes” and “sometimes” uses Facebook and/or health applications (apps)
- Uses ≥ 1 of 4 high-dependability sources “sometimes” and “never” uses Facebook and/or health apps

Low or indeterminate dependability (Facebook/Twitter, health-related apps, Google, WebMD, other unspecified website)

- Uses ≥ 2 of 3 low-dependability sources “often” or “sometimes”
- Uses ≥ 1 of 3 low-dependability sources “sometimes” but all 4 high-dependability sources “never”
- Uses ≥ 1 of 3 low-dependability sources “often” but no more than 1 high-dependability source “ever”
- Uses Facebook and/or health-related apps “often”
- Uses ≥ 2 of 3 low-dependability sources “often” and uses Facebook and/or health-related apps “sometimes”
- Uses high-dependability sources “never” and uses Facebook and/or health-related apps “sometimes”

No internet source used: respondent specified that she never gets health information online

In-person sources

High dependability (family physician, urgent care/clinic, children’s school, radio, or newspaper)

- Uses both family doctor and urgent care/clinic “often”
- Uses ≤ 1 low-dependability source “often”
- Uses ≥ 2 high-dependability sources at least “sometimes” and < 3 low-dependability sources “often”

Low or indeterminate dependability (family friend, coworker, or television)

- Uses high-dependability sources “never”
- Uses ≥ 2 low-dependability sources “often” and no more than 1 high-dependability source “often”
- Uses ≥ 1 low-dependability source “often” and no high-dependability sources used “often”

race/ethnicity (categorized as White, Hispanic/Latino, or “other” [Black/African American, American Indian/Alaska Native, Asian, or any open-ended response that was neither White nor Hispanic]), and Arizona county of residence (dichotomized as rural or urban).

Additional covariates were level of concern about ZIKV (dichotomized as low/no concern vs moderate/high concern) and knowledge of mosquito-breeding capabilities. The latter was scored 0-3 on the basis of correct endorsement or rejection of the following 5 statements: only some mosquito species can transmit diseases, some mosquitos can lay eggs inside your house and live in the house with you, mosquitos can only lay their eggs in natural waters like ponds and lakes, mosquitos lay their eggs in manmade containers with water like buckets or tires, and different mosquitos like different types of water; the latter 3 questions were mutually exclusive response options to the same question. We categorized respondents who correctly answered < 1 question as having a low level of knowledge; respondents who correctly answered 2 questions, a moderate level; and respondents who correctly answered 3 questions, a high level. Finally, we categorized respondents’ most preferred, most used health information

sourcing methods, whether online or in person, as being of high or low/indeterminate dependability (Box).

Statistical Analysis

We first performed descriptive analyses of demographic variables, sources of ZIKV knowledge, and relevant covariates, with respondents stratified by women who were pregnant or intended to become pregnant vs other women of childbearing age. We used Pearson χ^2 tests to test differences in covariates of interest between the 2 groups of women; we set significance a priori as $\alpha \leq .05$. We compared the ZIKV knowledge of women of childbearing age who said they frequently used internet sources to find health information by their sources of information.

We used Poisson regression models with robust variance to estimate knowledge of the sexual transmission of ZIKV among women who were pregnant or intended to become pregnant compared with other women of childbearing age.²⁶ We estimated goodness-of-fit for each model using the deviance goodness-of-fit test and Pearson χ^2 tests. The adjusted model controlled for age group, rural/urban county of

residence, and race/ethnicity (ie, the available demographic predictors collected in the survey). We estimated both unadjusted prevalence ratios (PRs) and adjusted prevalence ratios (aPRs) and 95% CIs.

We used multinomial logistic regression models to explore associations with most used health information sources and to address whether any behavioral or demographic characteristics predicted knowledge of sexual transmission of ZIKV among women who were pregnant or intended to become pregnant compared with other women of childbearing age. ZIKV knowledge, the outcome of interest, was categorized as (1) had never heard of ZIKV before the survey, (2) had heard of ZIKV and knew it was transmitted by mosquitos (the reference group), and (3) additionally knew about sexual transmission of ZIKV. The primary predictor was either low or high dependability for both in-person and online sources (with “no internet use” as the reference category for online sources). We estimated both unadjusted relative risk ratios (RRRs) and adjusted relative risk ratios (aRRRs, the ratio of the probability of choosing a given outcome category vs the reference category)²⁷ and 95% CIs, where the adjusted model included demographic factors and level of concern about ZIKV and knowledge of mosquito-breeding capabilities, which were included to account for the likelihood of having previously sought out ZIKV information. Multinomial logistic regression is used to model a linear combination of the log odds of nominal outcome variables, where the resulting linear equations can be exponentiated to yield RRRs per 1-unit change in the predictor.^{27,28} We estimated goodness-of-fit for each model using the *C* statistic estimated using the *mlogitroc* command, which generates multiclass receiver-operating characteristic curves for classification accuracy using bootstrapping methods and smoothed probability distributions derived from kernel density estimation.²⁹ We tested the sensitivity of the unadjusted and adjusted models by recategorizing 2 in-person sources of information (removing radio and newspaper from the categorization scheme) because, although these 2 sources were likely to provide trustworthy information, we could not assess this assumption with a high degree of certainty. We performed all analyses in Stata version 14 (StataCorp LLC).

Results

Of 710 women of childbearing age, 95 (13.4%) were pregnant or intended to become pregnant. Most of the women aged 18-49 were aged 18-31. Hispanic women who were pregnant or intended to become pregnant were more likely to report moderate to high concern about ZIKV than other Hispanic women of childbearing age (77.1% vs 58.4%; $P = .02$), but this difference was not significant among White women (57.1% vs 43.5%, respectively; $P = .11$) or women of other races/ethnicities (75.0% vs 55.1%, respectively; $P = .18$). Of women who were pregnant or intended to become pregnant, 20 (21.1%) said they had never heard of ZIKV, similar to the proportion (18.2%) of all other women of

childbearing age (Table 1). Women who were pregnant or intended to become pregnant reported using high-dependability in-person sources of information proportionally more frequently than other women of childbearing age (89.5% vs 78.9%; $P = .02$; Table 2). High-dependability online information sources were infrequently preferred (24.2% of women who were pregnant or intended to become pregnant and 22.0% of other women of childbearing age). Women of childbearing age who had never heard of Zika used internet sources of health information such as Facebook more often—and used high-reliability sources such as the CDC website less often—than women of childbearing age who knew about Zika (Figure).

Primary Analysis

We found a weakly positive, nonsignificant association between being pregnant or intending to become pregnant and knowledge of sexual transmission of ZIKV as compared with other women of childbearing age in both the unadjusted (PR = 1.13; 95% CI, 0.83-1.54) and adjusted (aPR = 1.14; 95% CI, 0.83-1.55) models. Approximately one-third of respondents (33.7% of women who were pregnant or intended to become pregnant and 29.9% of other women of childbearing age) knew about sexual transmission, whereas approximately half of respondents (45.3% of women who were pregnant or intended to become pregnant and 51.9% of other women of childbearing age) only knew about mosquito-borne transmission (vs never having heard of ZIKV or selecting only incorrect methods of transmission). Estimates of model fit did not indicate lack of fit for either model.

Secondary Analysis

The secondary analysis of the effect of health information source dependability on ZIKV knowledge found no significant differences in either unadjusted or adjusted models (Table 3). Using the internet to find health information, whether high- or low-dependability sources, was not associated with extent of ZIKV transmission knowledge, but we did observe nonsignificant qualitative trends consistent with the descriptive analysis that any internet use was associated with better ZIKV knowledge than no internet use. The aRRR for knowing about sexual transmission vs mosquito-borne transmission alone was 1.53 (95% CI, 0.70-3.32) for high-dependability sources and 1.14 (95% CI, 0.57-2.28) for low-dependability sources, and the aRRR for never having heard of ZIKV vs mosquito-borne transmission alone was 0.74 (95% CI, 0.30-1.83) for high-dependability sources and 0.64 (95% CI, 0.29-1.38) for low-dependability sources. We did not observe this trend for depending on high-dependability in-person information sources vs low-dependability in-person information sources: the aRRR for knowing about sexual transmission vs mosquito-borne transmission alone was 0.90 (95% CI, 0.53-1.52), and the aRRR for never

Table 1. Descriptive statistics for respondents to an online survey of Zika virus knowledge in Arizona, 2017^a

Characteristic	Women who are pregnant or intend to become pregnant in the next year (n = 95)	All other women of childbearing age (n = 615)	P value ^b
Age, y			<.001
18-24	31 (32.6)	179 (29.1)	
25-32	43 (45.3)	180 (29.3)	
33-39	16 (16.8)	128 (20.8)	
40-49	5 (5.3)	128 (20.8)	
>49	0	0	
Race/ethnicity			.19
White	35 (36.8)	272 (44.2)	
Hispanic	48 (50.5)	250 (40.7)	
Other ^c	12 (12.6)	93 (15.1)	
Urban or rural county of residence			.13
Predominantly urban (2 counties)	73 (76.8)	511 (83.1)	
Predominantly rural (13 counties)	22 (23.2)	104 (16.9)	
Level of knowledge of mosquito transmission risks			.90
High	22 (23.2)	132 (21.5)	
Moderate	46 (48.4)	296 (48.1)	
Low	27 (28.4)	187 (30.4)	
Moderate or high level of concern about Zika risk	66 (69.5)	340 (55.3)	.01
Knowledge of Zika			.48
Never heard of Zika	20 (21.1)	112 (18.2)	
Knows Zika can be transmitted by unprotected sex	32 (33.7)	184 (29.9)	
Only knows about mosquito-borne transmission	43 (45.3)	319 (51.9)	

^aSecondary analysis of a 2017 survey of Arizona residents; details of the primary data analysis available elsewhere.²⁵ All values are number (percentage) unless otherwise indicated; percentages may not add to 100 because of rounding.

^bPearson χ^2 tests used to test differences in covariates of interest; $P \leq .05$ considered significant.

^cOther included Black/African American, American Indian/Alaska Native, Asian, or any open-ended response that was neither White nor Hispanic.

having heard of ZIKV vs mosquito-borne transmission alone was 1.02 (95% CI, 0.59-1.77). Estimates of model fit were poor for both the unadjusted and adjusted models (C statistic = 0.557 and 0.605, respectively).

Sensitivity Analysis

When we excluded radio and newspapers from the categorization scheme of information sources, which added 19 participants to the low-dependability in-person information source category, we found no practical or significant changes in RRRs, 95% CIs, or model fit for either the adjusted or unadjusted model (Table 4).

Discussion

Levels of knowledge of sexual transmission of ZIKV were low among surveyed women in Arizona in 2017, long after

this knowledge should have penetrated into public health messaging for women who were pregnant or intended to become pregnant. These women were more likely to get in-person health information from highly reliable in-person sources than were other women of childbearing age, likely because they had more recent or frequent interactions with these sources (eg, primary health care providers) than other women; however, this use of reliable in-person sources did not translate into better ZIKV knowledge. This lack of knowledge is particularly relevant in Arizona and throughout the US–Mexico border region, where networks of work-related internal and international migration may create differential exposure to sexual transmission of ZIKV for women after a partner's mosquito-borne exposure to the virus in another zone. During a recent dengue outbreak in southern Arizona, 76% of surveyed Arizonans reported traveling weekly or monthly to Mexico.²⁰

Table 2. Responses to an online survey of Zika virus knowledge, by dependability of most frequently used information sources, Arizona, 2017^a

Characteristic	Women who are pregnant or intend to become pregnant in the next year (n = 95)	All other women of childbearing age (aged 18-49; n = 615)	P value ^b
In-person health information sources			.02
Most frequently gets in-person health information from low-dependability sources ^c	10 (10.5)	130 (21.1)	
Most frequently gets in-person health information from high-dependability sources ^d	85 (89.5)	485 (78.9)	
Online health information sources			.34
Most frequently gets online health information from low-dependability sources ^e	68 (71.6)	427 (69.4)	
Most frequently gets online health information from high-dependability sources ^f	23 (24.2)	135 (22.0)	
Does not use the internet to get health information	4 (4.2)	53 (8.6)	

^aSecondary analysis of a 2017 survey of Arizona residents; details of the primary data analysis are available elsewhere.²⁵ All values are number (percentage) unless otherwise indicated.

^bPearson χ^2 tests used to test differences in covariates of interest; $P \leq .05$ considered significant.

^cDefined as family friend, coworker, or television.

^dDefined as family doctor, urgent care/clinic, children's school, radio, or newspaper.

^eDefined as Facebook/Twitter, health-related applications, Google, WebMD, or other unspecified website.

^fCenters for Disease Control and Prevention website, Mayo Clinic website, Arizona Department of Health Services website, or official county health website.

ZIKV prevention campaigns in Arizona during 2016-2017 focused on mosquito-avoidance behaviors, which was reflected in our findings that although approximately 80% of respondents had heard of mosquito-borne ZIKV, fewer than half of the 80% reported knowing that sexual transmission was possible. An analysis of the Arizona Department of Health Services' ZIKV awareness campaign found that only 50% of 270 respondents felt that static advertisements (eg, billboards, bus posters) increased awareness of sexual transmission. In contrast, 68% of respondents believed that the campaign's printed ZIKV prevention brochure more effectively increased awareness of sexual transmission. The static advertisements focused on ZIKV risks while on vacation, on a honeymoon, or in backyards. These advertisements were correctly perceived by respondents as targeting pregnant women but were not seen as having a clear focus on sexual transmission or how to prevent it. Overall, female respondents of childbearing age found the campaign to be most effective at addressing travel concerns and at-home risks and to be less effective at explaining sexual transmission risks.³⁰

Our results suggest that women of childbearing age who predominantly relied on high-dependability internet sources were more likely to know about sexual transmission—and have heard of ZIKV—than women of childbearing age who never used the internet to find health information or women of childbearing age who relied on low-dependability sources. Any use of the internet to find health information appeared to protect against the lack of ZIKV awareness or lack of knowledge of sexual transmission. Many general health-related

information online sources (eg, WebMD) or other unspecified websites (categorized as “other site” on the survey) may provide correct information about routes of exposure, symptoms, and outcomes of ZIKV disease or other diseases; however, these sources are unlikely to clarify local or seasonal risk, which are especially important considerations for ZIKV. Basch et al³¹ found that most ZIKV information on highly reliable websites (eg, websites with a .gov extension) was written at a higher-than-recommended reading level, which may contribute to lower rates of use of high-dependability internet sources as compared with low-/indeterminate-dependability sources and a preference for high-dependability in-person sources such as medical providers. Health-related applications (apps) may provide high-quality information, but our survey could not distinguish between the types and quality of apps that respondents reported using.

Limitations

Our study had several limitations. First, we had no information on the sociodemographic factors (eg, education level, socioeconomic status) that may predict information-sourcing preferences. In-depth studies are needed to understand why some people knew about sexual transmission and others did not. Second, only 1.0% of respondents completed the survey in Spanish, which may suggest a sampling bias toward Hispanic women residing in the United States if language is considered a proxy for acculturation. Third, we did not record reasons for survey nonresponse, so we could not

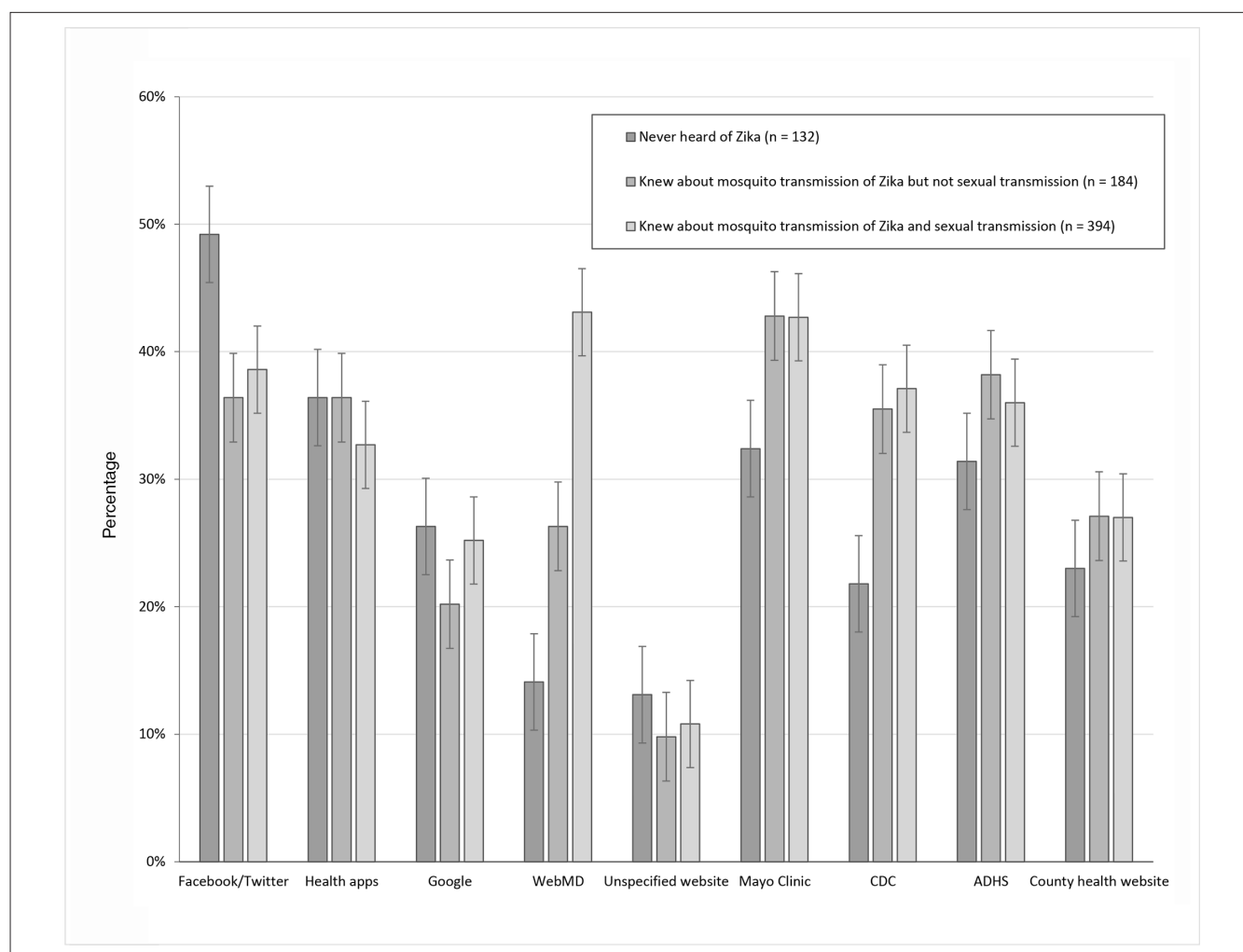


Figure. Proportion of women aged 18-49 responding to an online survey of Zika virus knowledge who frequently used internet sources, by level of reported Zika virus knowledge, Arizona, 2017. Of 710 respondents, 57 (8.0%) said they never obtain health information online, of whom 18 had never heard of the Zika virus. Error bars indicate 95% CIs. Data source: secondary analysis of a 2017 survey of Arizona residents; details of the primary data analysis available elsewhere.²⁵ Abbreviations: ADHS, Arizona Department of Health Services; CDC, Centers for Disease Control and Prevention.

evaluate selection bias. Relative to 2010 census information on women aged 18-49 in Arizona, our sample had a similar proportion of Hispanic women (42% of our sample vs ~40% of women in Arizona)³²; 1.0% of our sample completed the survey in Spanish, whereas 20.8% of people living in Arizona speak Spanish as their primary language.³³ Fourth, it was not possible to assign any attributes to the health information that respondents reported from sources of indeterminate dependability, such as their children's schools. Fifth, our survey captured only partial data on hybridized personal-online interactions that may include dissemination of health information, such as chat groups with family or friends via platforms such as WhatsApp or Facebook Messenger. We were unable to assess, for example, how women who reported relying on family or friends for health information received that information—through literal word of mouth or through

mobile media shared by trusted personal contacts. Platforms such as WhatsApp enable instantaneous sharing of infographics, web links, videos, or written text, which superficially seem trustworthy and require no fact checking on the part of the sender or receiver and may represent a critical point for public health intervention.^{34,35}

Conclusions

We found that as late as June 2017, in the second year of local transmission of ZIKV in the United States, women in Arizona were not receiving sufficient information about the sexual transmission of the virus even though this information was available via multiple media, including health care providers and health authority websites. More work is needed to

Table 3. Factors associated with the likelihood of knowing about the sexual transmission of Zika virus relative to the most relied-upon health information sources of women of childbearing age (aged 18-49) in an online survey of Zika virus knowledge, Arizona, 2017^a

Factor	Unadjusted model, relative risk ratio (95% CI)		Adjusted model, ^b relative risk ratio (95% CI)	
	Knew about sexual transmission vs mosquito transmission alone	Never heard of Zika vs mosquito transmission alone	Knew about sexual transmission vs mosquito transmission alone	Never heard of Zika vs mosquito transmission alone
Internet sources				
No internet sources	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Low dependability ^c	1.30 (0.66-2.56)	0.56 (0.27-1.17)	1.14 (0.57-2.28)	0.64 (0.29-1.38)
High dependability ^d	1.74 (0.82-3.70)	0.59 (0.25-1.38)	1.53 (0.70-3.32)	0.74 (0.30-1.83)
In-person sources				
Low dependability ^e	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
High dependability ^f	0.76 (0.51-1.15)	0.90 (0.53-1.52)	0.75 (0.49-1.14)	1.02 (0.59-1.77)
C statistic	0.557		0.605	

^aSecondary analysis of a 2017 survey of Arizona residents; details of the primary data analysis are available elsewhere.²⁵ Multinomial logistic regression, with women who had only heard of mosquito-borne Zika virus as the reference.

^bAdjusted for the category of women who were pregnant or intended to become pregnant, age category, race/ethnicity, knowledge of mosquito-breeding capabilities, and level of reported concern about Zika.

^cDefined as family friend, coworker, or television.

^dDefined as family doctor, urgent care/clinic, children's school, radio, or newspaper.

^eDefined as Facebook/Twitter, health-related applications, Google, WebMD, or other unspecified website.

^fDefined as Centers for Disease Control and Prevention website, Mayo Clinic website, Arizona Department of Health Services website, or official county health website.

Table 4. Sensitivity analysis of the relative risk of likelihood of knowing about sexual transmission of Zika virus relative to the most relied-upon health information sources of women of childbearing age (aged 18-49) using redefined criteria for high-dependability in-person sources, Arizona, 2017^a

Factor	Unadjusted model, relative risk ratio (95% CI)		Adjusted model, ^b relative risk ratio (95% CI)	
	Knew about sexual transmission vs mosquito transmission alone	Never heard of Zika vs knew about mosquito transmission alone	Knew about sexual transmission vs mosquito transmission alone	Never heard of Zika vs knew about mosquito transmission alone
No internet sources				
No internet sources	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Low dependability ^c	1.31 (0.67-2.60)	0.57 (0.27-1.18)	1.14 (0.57-2.31)	0.64 (0.29-1.38)
High dependability ^d	1.74 (0.82-3.70)	0.59 (0.25-1.38)	1.53 (0.70-3.31)	0.74 (0.30-1.82)
In-person sources				
Low dependability ^e	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
High dependability ^f	0.76 (0.51-1.15)	0.90 (0.53-1.52)	0.77 (0.51-1.16)	1.09 (0.65-1.85)
C statistic	0.505		0.601	

^aSecondary analysis of a 2017 survey of Arizona residents; details of the primary data analysis are available elsewhere.²⁵ Multinomial logistic regression, with women who had only heard of mosquito-borne Zika virus as the reference. Sensitivity analysis removed newspaper and radio from the categorization scheme and moved 19 study participants from high dependability to low dependability in category for in-person sources of information.

^bAdjusted for category of women who were pregnant or intended to become pregnant, age category, race/ethnicity, knowledge of mosquito-breeding capabilities, and level of reported concern about Zika.

^cDefined as family friend, coworker, or television.

^dDefined as family doctor, urgent care/clinic, children's school, radio, or newspaper.

^eDefined as Facebook/Twitter, health-related applications, Google, WebMD, or other unspecified website.

^fDefined as Centers for Disease Control and Prevention website, Mayo Clinic website, Arizona Department of Health Services website, or official county health website.

determine which aspects of the intended prevention campaigns were ineffective or inefficient, as well as within-population differences in information access, to prepare for possible future outbreaks. The influence of interpersonal networks (eg, perceived authority of the person providing information) has not been sufficiently considered in the spread of public health information and misinformation, both online and in person. For example, WhatsApp, Facebook, and Instagram have been linked to the spread of misinformation about ZIKV, vaccine safety, and COVID-19 and subsequent failure of public health initiatives,³⁶⁻³⁸ yet no effective internet-based approaches have been identified to mitigate this problem.

Our study indicates a broad need to empirically identify and aggressively target the health information sources of populations who are especially vulnerable to ZIKV or other infectious diseases, beyond making accurate information available on trustworthy websites or disseminating information to health care professionals. Targeted campaigns that highlight the risks of sexual transmission of ZIKV to women who are pregnant or intend to become pregnant are warranted wherever risks for ZIKV exposure remain.

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