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Sources Affecting Knowledge and Behavior Responses to the Zika Virus in U.S. Households with Current Pregnancy, Intended Pregnancy, and a High Probability of Unintended Pregnancy

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Abstract

Background.

This study examined the influences of information sources on Zika-relevant knowledge and behaviors in U.S. households containing members who are pregnant, intend to become pregnant, or have a higher probability of unintended pregnancy in Zika-affected regions (i.e., respondents who are younger, are black, have less education, are unmarried, and reside in the southern U.S.).

Methods.

Over twenty-two thousands U.S. adults completed a survey measuring Zika-relevant knowledge and behaviors along with information sources (e.g., discussing Zika with practitioners), general media usage (e.g., TV), and demographic information over 30 weeks.

Results.

Respondents in the group with (vs. without) either pregnancy or intended pregnancy were more likely to use all information sources, which in turn created differences in knowledge and behavior responses. To gauge information sources in US-South respondents with a high probability of having a household member with unintended pregnancy based on demographics, younger, less-educated, unmarried, black respondents had fewer Zika discussion with practitioners than another group.

Conclusions.

Efforts to increase Zika-related knowledge and protective behaviors should target households with members who are pregnant or intending to become pregnant via practitioners, family, and friends. Additional efforts should target information channels to reach younger, less educated, unmarried, black respondents, which are at risk for unintended pregnancy.

Introduction

The Zika virus is a mosquito-borne flavivirus recently related to a number of human diseases, including microcephaly and possibly Guillain-Barre syndrome.[1] On February 1, 2016, the World Health Organization declared the ongoing Zika crisis an *emergency*.[2] The virus is primarily transmitted by the bite of the female *Aedes* mosquito species, the same vector that transmits yellow fever, dengue fever, and chikungunya. Zika can be passed from a mother to her fetus during pregnancy and can also be sexually transmitted from infected people to their partners. In eight out of ten cases, the person carrying the virus is asymptomatic. Infection with Zika is diagnosed based on a blood or urine test. There is no available treatment to cure or vaccine to prevent infections, which increases the need to understand how to best inform the population on transmission and preventive practices.[2–4] As of January 18, 2017, the Zika virus infections are notifiable conditions in the U.S., which has resulted in 4,900 reported cases, 96% associated with traveling outside the U.S.[5,6]

Even though infection during pregnancy can result in several fetal impairments (i.e., microcephaly, defects of eyes, hearing deficits, and impaired growth),[7,8] U.S. studies have suggested low levels of knowledge about Zika transmission and limited practice of behaviors that help to prevent infections.[9–11] Therefore, increasing population knowledge about Zika and about means to prevent Zika infection is critical from a public health perspective.[4,12] Key populations involve members of households with pregnant women, women who intend to get pregnant, and women who might unintentionally become pregnant based on respondents' demographic characteristics and who live in the South of the U.S. (i.e., an area of active Zika virus transmission).[5,13] This paper presents the first survey continuously administered by phone (landlines and cell phones) to a nationally representative sample in the U.S. over 30 weeks from February 16 to September 4 in 2016.

The present study contributes to previous work by (a) examining different measures of knowledge, behavioral intentions and behaviors, such as changing travel plans and wearing mosquito repellent to reduce the chance of mosquito-bites, and (b) determining the likely sources of knowledge and behavioral responses, including discussions with practitioners, discussions with friends and family, seeking information online, and general media use (e.g., social media, newspapers, online news, television, and radio) in samples with or without either pregnancy or intended pregnancy (i.e., *samples from households with either pregnancy or intended pregnancy vs. neither pregnancy nor intended pregnancy*), samples

from households with pregnancy intentions (i.e., *the pregnancy-intention- vs. current-pregnancy-groups*), and samples with demographic characteristics associated with unintended pregnancy (i.e., *less-educated unmarried black respondents vs. other respondents*) who also live in Zika-affected regions. Importantly, unintended pregnancy rates are highest among unmarried women, women who are black, and women with less education/income.[14–17] Therefore, we selected younger respondents who reside in the region of active Zika transmissions and have household members with neither current nor intended pregnancy and then compared those who are less-educated, unmarried, and black with others to understand the information sources of this at-risk population as well. The guiding research questions of our analyses included: Are there differences in information sources across groups? Do these information sources mediate differences in knowledge and behaviors across these samples?

Method

Sample and Survey Design

We conducted a survey of knowledge, behavioral intentions, and behaviors relevant to Zika over 30 weeks. Each weekly, dual-frame sample was designed to represent the adult U.S. population (including Hawaii and Alaska) and used a fully-replicated, single-stage, random-digit-dialing (RDD) sample of landline telephone households, along with randomly generated cell phone numbers. Each weekly wave consisted of 1,000 interviews of which at least 600 were obtained from cell phone respondents. Within each landline household, a single respondent (youngest adult) was selected. Cell-phone respondents were considered separately from landlines as the interview may take place outside the respondent's home. Surveys were conducted over a 5-day period, in English and Spanish, typically from Wednesday through Sunday, to include both weekdays and weekends. Each weekly wave was weighted to provide nationally representative and projectable estimates of the adult population 18 years of age and older. The weighting process takes into account the disproportionate probabilities of household and respondent selection due to the number of separate telephone landlines and cell phones answered by respondents and their households, as well as the probability associated with the random selection of an individual household member. Following application of the above weights, the sample is post-stratified and balanced by key demographics such as age, race/ethnicity, sex, the region of residence, and education. The

sample is also weighted to reflect the distribution of phone usage in the general population, meaning the proportion of those who are cell phone only, landline only, and mixed users. The average response rate over the weeks was 7.5%, and over thirty-two thousand and eight hundred U.S. adults completed the survey over 30 weeks. (More details about the survey design can be found in the supplementary material).

We combined respondents' answers to questions about the pregnancy status and intentions to get pregnant by members in the households, together with questions about demographic characteristics (i.e., age, the highest education level attained, race/ethnicity, and marital status), and the geographic residence region to identify vulnerable samples. The first sample contained respondents from households with vs. without members who are either pregnant or intending to become pregnant (i.e., *samples from households with either pregnancy or intended pregnancy vs. neither pregnancy nor intended pregnancy*), N = 24,459. The second sample consists of respondents from households with members, who are currently vs. intending to get pregnant (i.e., *the pregnancy-intention- vs. current-pregnancy-groups*), N = 1,465. The third sample includes younger respondents (i.e., aged below 25), who live in Zika-affected regions (i.e., the Southern regions) and have households members, who do not intend to become pregnant. Specifically, the third sample includes less-educated (i.e., less than a college degree) unmarried black respondents, N = 880. Table I presents descriptive characteristics of different samples. Details about the survey items appear next.

Measures

Demographics. Respondents answered questions about their sex, age, marital status, the highest education level they attained, and their region of residence. We then categorized their responses into groups: *age* = Aged 24 or below vs. aged 25 or above; *marital status* = Unmarried (i.e., single never married or cohabiting) vs. married, *education* = Without a college degree vs. with a college degree or a postgraduate/professional degree; and *region of residence* = U.S.'s south where reported most Zika infections vs. other U.S. regions.

Household current or intended pregnancy. We used two questions with a dichotomous response of *yes* and *no* to determine the pregnancy grouping of the respondents' household, i.e., *As far as you know, is anyone in your household currently pregnant?,* and , *as far as you know, is anyone in your household considering getting pregnant within the next 12 months?,* in different samples. The sample of pregnancy or intended pregnancy contains

respondents who answered *yes* to both or either of the questions (coded as -1) and is contrasted with respondents who answered *no* to both questions (coded as 1). The *pregnancy-intention-group* includes those who answered *yes* to the second question (coded as 1) and is contrasted with *the current-pregnancy-group* (coded as -1), which includes respondents who answered *yes* to the first question. The *unintended-pregnancy-probability-sample* includes younger respondents who reside in the South of the U.S. and answered *no* to both questions. This sample contrasts respondents who are less-educated, unmarried, and black (coded as 1) with those without these characteristics (coded as -1).

Sources of Zika information and media usage. Respondents also reported whether they discussed Zika with practitioners, discussed it with family and friends, sought such information online, and used other media, including forwarding information about ZIKA online, using online news sites, reading newspapers online or offline, listening to public radio online or offline, watching television online or offline, and using social media such as Twitter and Facebook. The question about forwarding information about Zika online had the dichotomous choices of *yes* and *no,* whereas the other questions had a polychotomous scale (1= *never* to 7 = *many times a day*) on which to indicate use.

Knowledge. Respondents answered four questions on a polychotomous scale (1= *not at all accurate/likely* to 4 = *very accurate/likely*), to indicate their level of knowledge of Zika (see Table SI). Two questions were about how Zika is transmitted: Mosquito bites and sex. The other questions were about Zika infection symptoms and outcomes, including the association between Zika and microcephaly and whether or not Zika infections always produce noticeable symptoms (this is an incorrect item, and the responses were reverse coded to indicate the level of accurate knowledge).

Behavioral intentions and behaviors. For behaviors related to Zika, respondents answered questions about the likelihood that they would change their travel plans if they learned about an outbreak of Zika in their travel destination, and the likelihood that they would receive a Zika vaccine if one were available (see Table SI). Furthermore, respondents were asked an open-ended question about whether they engaged in any behaviors to protect them from becoming infected with Zika in the past three months. The protective behaviors listed included purchasing/wearing insect repellent, wearing long-sleeved shirts and pants, and removing standing water.

Statistical Analyses

The number of weeks for which each question was asked in the survey was not identical because some questions were rotated in and out of the survey during the survey period. Given the presence of systematic missing data, it is inappropriate to apply any imputation techniques, which assume the missing data to be random. Therefore, we used ordinal logistic regression to analyze each knowledge and behavior response individually.

There were two steps in the statistical analyses: We first conducted logistic regressions to examine the relations between critical samples of comparison and sources of Zika information (i.e., path *a*), and then carried out ordinal logistic regressions to delineate the relations of sources of Zika information, including seeking information about Zika online, discussing Zika with practitioners, and discussing Zika with family and friends, with knowledge and behavior outcomes, while controlling for the indicators for the critical samples (i.e., path *b*). Ordinal logistic regression is an extension of logistic regression when the outcome is ordinal and has more than two responses. Therefore, we used logistic regression to analyze the behavior response – *taking protective behaviors,* due to its dichotomous nature. The same set of analyses was repeated separately for the three comparisons to make determinations about vulnerable groups (see Appendix A for additional comparisons of vulnerable groups with specific sociodemographic characteristics).

For the first analysis, which compared groups with or without either current or intended pregnancy, we examined whether the group variable was associated with information sources, and in turn, whether these sources led to differential knowledge and behavior outcomes between the groups. Rather than treating current and intended pregnancy as part of the same group, the second analysis compared the pregnancy-intention- vs. current-pregnancy-groups. The third analysis focused on the unintended-pregnancy-probability-sample of younger respondents at Zika-infected regions. This analysis included two groups (i.e., less-educated unmarried black vs. other respondents), which were entered in the analyses to study the relations with information sources of Zika and their mediating roles on knowledge and behavior outcomes.

Additionally, we included the main effects of sex, the week number during which the survey was completed, and media usage (i.e., forwarding information about Zika online, using online news sites, reading newspapers online or offline, listening to public radio online or offline, watching television online or offline, and using social media such as Twitter and

Facebook), as well as the interaction effects of information sources with sex, of information sources with the group variable, and of information sources with the region of residence (except the third sample) as covariates in each analysis.

For all three analyses, when paths *a* and *b* were both significant, we performed a Sobel test to determine whether the included mediator (i.e., seeking information about Zika online, discussing Zika with practitioners, or discussing Zika with family and friends) was significant. The Sobel test computes the two regression paths described above (i.e., paths *a* and *b*), together with the variances as a ratio, and treats the ratio as a *z*-test. These analyses test whether an information source mediates differences in knowledge of behavior between those groups.

Results

Tables II, III, and IV present the results of three critical samples. Path *a* indicates whether there were any between-group differences in information sources. Path *b* represents the correlation of information sources with knowledge and behavior responses. Path *c*' shows the association of the group variable with knowledge and behavior responses when taking the mediator into account. The analyses of each critical sample had different *Ns* because of different sampling criteria and the presence of missing responses to different survey items. The *N*s of each knowledge and behavior responses ranged: Sexually-transmitted = 872 – 14,571, mosquito-transmitted = 904 – 15,452, microcephaly = 932 – 15,970, noticeable symptoms = 924 – 15,822, change of travel plans = 709 – 12,274, get vaccinated if available = 361 – 5,918, and taking protective behaviors = 656 – 11,544.

Are there differences in information sources as a function of the critical samples? Do information sources mediate group differences in knowledge and behaviors?

The comparison of samples from households with either pregnancy or intended pregnancy vs. neither pregnancy nor intended pregnancy. Table II showed significant differences in all information sources between groups with or without either pregnancy or intended pregnancy (i.e., paths *a*, *p*s < .001). Furthermore, some information sources correlated with knowledge and behaviors (paths *b*). For example, seeking Zika information online and discussing Zika with family and friends were associated with knowledge about sexual transmission and microcephaly, and with behavioral intentions to change travel plans.

Additionally, several of the knowledge and behavior responses (i.e., sexually-transmitted, microcephaly, change of travel plans, get vaccinated if available, and taking protective behaviors) differed across groups as well (see Table SII), thus comprising plausible mediations of the differences in knowledge and behavior.

As revealed by the Sobel tests, all three information sources significantly explained the differences between groups with or without either pregnancy or intended pregnancy in knowledge and behavior outcomes (see Table II). For example, seeking information online completely mediated (i.e., path *c'* was non-significant) the link between the group variable and knowledge about microcephaly, Sobel test = -2.08, p = . 0375, and changing travel plans, Sobel test = 2.92, p = .0035. Moreover, discussing Zika with practitioners completely mediated the links between the group variable and two knowledge outcomes, i.e., the mosquito-transmitted nature of Zika, Sobel test = 2.20, p = .0278 and not always having noticeable symptoms, Sobel test = -2.27, p = .0232, while discussing it with family and friends only showed a complete mediation of group differences in knowledge of microcephaly, Sobel test = -2.07, p = .0385. In summary, the group with (vs. without) either pregnancy or intended pregnancy was more likely to seek information online and talk about Zika with practitioners, family and friends, and these factors led to higher levels of knowledge. The effects of seeking online information and talking with practitioners were stronger than the effects of discussing Zika with family and friends.

The comparison of pregnancy intentions vs. current pregnancy. Table III shows a consistent information source differences between the pregnancy-intention- and current-pregnancy-groups. Specifically, respondents of households with members who intend to get pregnant, compared to those who are pregnant, were less likely to discuss Zika with practitioners or with family and friends (see Table III). However, seeking information online was more popular among those in the pregnancy-intention-group, b = 0.38, SE = 0.19, p = .0510. In summary, samples with pregnancy intentions (vs. current pregnancy) sought information online but talked with practitioners, family, and friends less. Furthermore, because information sources did not mediate differences in knowledge and behaviors, the differences in information sources had little consequence.

The unintended-pregnancy-probability-sample of younger respondents in Zika-affected regions. We also examined whether information sources differed as a function of two unintended-pregnancy-groups: Less-educated unmarried black respondents vs. others. As

shown in Table IV, less-educated unmarried black respondents were less likely to discuss Zika with practitioners than other respondents, b = -1.72 – -2.34, SE = 0.74 – 1.03, p = .0209 – .0266. The results showed no significant associations between information sources and knowledge and behaviors measures, indicating the lack of mediating effects of information sources.

Discussion

Main finding of this study. The results from our study revealed three major findings. First, among people from households with (vs. without) either current or intended pregnancy, seeking information online explained differences in behavioral intentions of changing travel plans, whereas discussing Zika with practitioners, family, and friends only accounted for differences in knowledge measures (i.e., the mosquito-transmitted nature of Zika infections, the link between Zika infections and microcephaly, and the absence of noticeable symptoms in Zika infections). Second, the group with pregnancy intentions (vs. current pregnancy) was less likely to discuss Zika with practitioners, family, and friends but more likely to seek information online. Third, less-educated unmarried black respondents reported fewer discussions about Zika with practitioners than other respondents, and more importantly, both groups reported inadequate knowledge about asymptomatic infections of Zika (see Table I).

What is already known on this topic. A review of the literature resulted in more than a hundred records, and about six studies examined knowledge or behaviors related to Zika in the U.S. and the U.S. Virgin Islands.[9–11,18,19] In these studies, respondents had high levels of awareness, low levels of knowledge, and varying levels of protective behaviors.[9–11,18,19] Moreover, in prior research, people recalled hearing messages about mosquito-bites as a way of transmission but not the sexual transmission of Zika, and few recalled messages about taking specific protective behaviors.[10]

What this study adds. Respondents from households with members that are either currently or intending to become pregnant reported higher levels of knowledge, behavioral intentions, and behaviors than those with neither current nor intended pregnancy. However, there were no differences in knowledge that Zika infection can be asymptomatic (i.e., not always having noticeable symptoms) and low levels of knowledge about sexual transmission. In line with prior studies,[4,20] the findings are worrisome. Even though practitioners appear efficacious at

increasing knowledge about Zika, as judged by lack of significant mediation, they produce very small differences in behavioral intentions and behaviors. Moreover, according to our knowledge, the present study is the first one to report differences in the use of information sources between the pregnancy-intention- and current-pregnancy-groups. Specifically, the group with pregnancy intentions was less likely to discuss Zika with practitioners, suggesting limited contacts with practitioners or inadequate access to Zika information from practitioners. More importantly, this study found differences in the unintended-pregnancy-probability-sample of younger respondents in Zika-affected regions. Less-educated unmarried black respondents, compared to others, had fewer Zika discussions with practitioners. Lastly, both groups of younger respondents reported inadequate knowledge about asymptomatic infections of Zika (see Table I).

Limitations of this study. There are two limitations in the present study. First, the survey measures of pregnancy intentions and current pregnancy were about respondents' household members rather than the respondent themselves. Future studies may collect survey data from individual participants to determine whether our findings replicate at the individual level. Nonetheless, this study provided valuable information about households with pregnancy or intended pregnancy and their information sources. Second, the survey rotated some measures of knowledge, behavioral intentions, and behaviors in and out during the period of examination, leading to the presence of systematic missing data. Future work should investigate all explanatory variables for the full period to advance existing models and theories[21,22] in Zika infections.

Public Health Implications

The present study provides empirical evidence that the use of information sources differs across samples, which results in differences in knowledge, behavioral intentions, and behaviors. Therefore, our findings offer a call to action for practitioners, both in the clinical and public health domains, to deliver resources to individuals at-risk for Zika infection. We recommend health campaigns to capitalize on these critical sources and thus improve knowledge about the asymptomatic nature of Zika infection and increase behavioral intentions and behaviors in vulnerable populations. These actions include encouraging practitioners to thoroughly discuss these issues, disseminating accurate information via the

Internet, and opening new channels of communication for samples at risk for unintended pregnancy.

Outbreaks of Zika virus infection have been reported in Africa, the Americas, Asia and the Pacific,[23] and this widespread risk threaten women of childbearing age. More importantly, the long-term aftereffects for survivors impose high medical, societal and economic strains on the affected societies. The present findings urge all countries worldwide to make comprehensive preventive and control efforts in prenatal healthcare, family planning, and non-pregnancy related strategies. Such preventive strategies should promote discussions about Zika and the dissemination of Zika-related information in diverse channels. It is imperative to take deliberate efforts, particularly amongst pregnant women, women of childbearing age, and their partners, before an effective method is set in place to eliminate Zika vectors.

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Table I

Descriptive Statistics of All Samples

Variable	First		Second		Third	
	Either current or intended pregnancy	Neither	Pregnancy-intention-group	Current-pregnancy-group	Less-educated unmarried black respondents	Other respondents
N	1,568	22,891	947	518	122	758
Sex	50% females	51% females	51% females	50% females	46% females	41% females
Age						
Aged 24 or below	11%	10%	10%	12%	100%	100%
Aged 25 or above	89%	90%	90%	88%	0%	0%
Education						
Without a college degree	45%	40%	50%	38%	100%	77%
With a college degree or a postgraduate/professional degree	55%	60%	50%	62%	0%	23%
Ethnicity						
White	69%	76%	71%	68%	0%	66%
Black	11%	11%	10%	12%	100%	5%
Hispanics	20%	12%	18%	21%	12%	29%
At-risk region	42%	43%	43%	42%	100%	100%
Media usage						
Forwarding information online	19%	11%	18%	21%	10%	15%
Reading newspaper online and offline	3.99 (2.07)	4.05 (2.06)	4.05 (2.05)	3.91 (2.11)	3.36 (2.08)	3.36 (1.92)
Using online news sites	3.15 (2.23)	2.65 (2.11)	3.24 (2.24)	2.96 (2.20)	2.62 (1.93)	3.00 (2.07)
Listening to radio online and offline	4.15 (2.19)	3.89 (2.22)	4.20 (2.17)	4.04 (2.22)	3.74 (2.18)	3.73 (2.18)
Watching television online and offline	5.06 (1.90)	5.30 (1.79)	5.11 (1.87)	5.06 (1.88)	4.81 (2.01)	4.74 (1.93)
Usage frequency of Twitter	1.81 (1.68)	1.59 (1.46)	1.84 (1.70)	1.74 (1.62)	2.92 (2.35)	2.55 (2.18)
Usage frequency of Facebook	4.52 (2.35)	3.79 (2.45)	4.60 (2.33)	4.41 (2.38)	4.49 (2.20)	4.98 (2.10)
Seeking information about Zika online	46%	26%	47%	43%	33%	42%
Discussing Zika with practitioners	18%	7%	16%	22%	2%	10%
Discussing Zika with family and friends	43%	32%	42%	45%	26%	29%
Knowledge						

Variable	First		Second		Third	
	Either current or intended pregnancy	Neither	Pregnancy-intention-group	Current-pregnancy-group	Less-educated unmarried black respondents	Other respondents
Sexually-transmitted	2.99 (1.10)	2.84 (1.10)	2.97 (1.10)	2.99 (1.10)	2.82 (1.09)	2.89 (1.04)
Mosquito-transmitted	3.37 (0.86)	3.31 (0.87)	3.37 (0.85)	3.36 (0.87)	3.44 (0.79)	3.43 (0.76)
Microcephaly	3.40 (0.81)	3.35 (0.79)	3.42 (0.79)	3.37 (0.82)	2.97 (0.94)	3.14 (0.88)
Noticeable symptoms	2.67 (0.97)	2.67 (0.95)	2.72 (0.96)	2.63 (0.96)	2.37 (0.96)	2.58 (0.89)
Change of travel plans	3.22 (1.09)	3.05 (1.13)	3.14 (1.12)	3.37 (1.00)	3.42 (0.84)	3.10 (1.02)
Get vaccinated if available	2.80 (1.16)	2.50 (1.17)	2.80 (1.16)	2.84 (1.15)	2.80 (1.07)	2.84 (1.00)
Taking protective behaviors	35%	26%	32%	40%	21%	27%

Table II

Results of Mediation Analyses of the Comparison between Samples from Households with Either Current or Intended Pregnancy and Samples from Households with Neither Current nor Intended Pregnancy

Mediator	Knowledge															
	Sexually-transmitted				Mosquito-transmitted				Microcephaly				Noticeable symptoms			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	-0.44 (0.08) ***	0.31 (0.13) *	-0.19 (0.09) *	-2.19*	-0.42 (0.08)**	0.09 (0.13)	-0.11 (0.09)	-	-0.50 (0.07)**	0.30 (0.14)*	-0.16 (0.09)	-2.08*	-0.48 (0.07)**	0.20 (0.12)	-0.00 (0.08)	-
Discussing Zika with practitioners	-0.79 (0.09) ***	0.14 (0.17)	-0.22 (0.07) ***	-	-0.78 (0.09)**	-0.39 (0.17)*	0.13 (0.07)	2.20*	-0.75 (0.09)**	0.20 (0.18)	-0.13 (0.07)	-	-0.73 (0.09)**	0.38 (0.16) *	0.02 (0.07)	-2.27*
Discussing Zika with family and friends	-0.32 (0.07) ***	0.31 (0.13) *	-0.17 (0.09) *	-2.09*	-0.28 (0.07)**	0.11 (0.13)	-0.11 (0.09)	-	-0.33 (0.07)**	0.31 (0.13)*	-0.15 (0.09)	-2.07*	-0.33 (0.07)**	0.12 (0.12)	0.09 (0.08)	-

Mediator	Behavioral intentions and behaviors											
	Change travel plans				Get vaccinated if available				Taking protective behavior(s)			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	-0.35 (0.09) ***	0.67 (0.16) ***	-0.12 (0.10)	-2.92***	-0.54 (0.12)**	0.21 (0.20)	-0.33 (0.13)**	-	-0.36 (0.09)**	0.43 (0.18)*	-0.33 (0.12) ***	-2.01*
Discussing Zika with practitioners	-0.69 (0.10) ***	0.10 (0.20)	-0.3 (0.08) ***	-	-0.85 (0.14)**	0.51 (0.26)*	-0.30 (0.11)**	-1.86	-0.66 (0.11)**	1.00 (0.23)** *	-0.27 (0.10) **	-3.51***
Discussing Zika with family and friends	-0.36 (0.08) ***	0.34 (0.15) *	-0.31 (0.10) ***	-2.00*	-0.34 (0.12)**	0.44 (0.20)*	-0.26 (0.13)*	-1.76	-0.38 (0.08)**	0.68 (0.18)	-0.26 (0.13) *	-2.86***

Note. Samples from households with neither current nor intended pregnancy were coded as 1 whereas samples from households with either current or intended pregnancy were coded as -1. Unstandardized estimates and standard errors in parentheses. Main effects of sex, age group, level of education, at-risk region, week number of the survey completion, ethnicity, seeking Zika information online, discussing Zika with practitioners, discussing Zika with family and friends, forwarding information online, reading newspapers online and offline, using online news sites, listening to radio online and offline, watching television online and offline, usage frequency of Twitter, and usage

frequency of Facebook, were included for the estimations of paths *a* and *b*, while the interaction effects between the mediators and the group variable, sex, and at-risk region were included for the estimation of paths *b* and *c'*.
An italic font style indicates a partial mediation and a bold font style indicate a complete mediation.
*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Table III

Results of Mediation Analyses of the Comparison of the Pregnancy-Intention- vs. Current-Pregnancy-Groups

Mediator	Knowledge															
	Sexually-transmitted				Mosquito-transmitted				Microcephaly				Noticeable symptoms			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	0.31 (0.17)	0.12 (0.28)	-0.28 (0.18)	-	0.26 (0.16)	0.43 (0.3)	0.18 (0.18)	-	0.29 (0.16)	-0.20 (0.30)	-0.08 (0.19)	-	0.26 (0.16)	-0.04 (0.27)	0.08 (0.17)	-
Discussing Zika with practitioners	-0.52 (0.19)**	0.35 (0.34)	-0.05 (0.15)	-	-0.55 (0.18)**	-0.16 (0.36)	0.15 (0.16)	-	-0.47 (0.18)**	-0.27 (0.36)	-0.12 (0.16)	-	-0.48 (0.18)**	-0.21 (0.33)	0.08 (0.14)	-
Discussing Zika with family and friends	-0.26 (0.16)	0.49 (0.28)	-0.1 (0.18)	-	-0.26 (0.15)	0.41 (0.29)	0.27 (0.19)	-	-0.26 (0.15)	0.41 (0.29)	0.15 (0.19)	-	-0.25 (0.15)	-0.24 (0.26)	-0.03 (0.18)	-

Mediator	Behavioral intentions and behaviors											
	Change travel plans				Get vaccinated if available				Taking protective behavior(s)			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	0.38 (0.19)*	0.25 (0.36)	-0.64 (0.21)***	-	0.16 (0.26)	0.65 (0.45)	0.23 (0.29)	-	0.21 (0.20)	0.51 (0.42)	-0.19 (0.25)	0.31
Discussing Zika with practitioners	-0.44 (0.22)*	-0.02 (0.46)	-0.47 (0.19)**	-	-0.03 (0.30)	0.82 (0.55)	0.35 (0.24)	-	-0.40 (0.23)	1.27 (0.52)**	-0.38 (0.22)	-1.47
Discussing Zika with family and friends	-0.42 (0.18)*	0.32 (0.35)	-0.35 (0.23)	-	-0.16 (0.25)	1.23 (0.44)**	0.50 (0.29)	-	-0.32 (0.19)	0.90 (0.43)*	-0.2 (0.29)	-1.25

Note. The pregnancy-intention-samples were coded as 1 whereas the current-pregnancy-samples were coded as -1. Unstandardized estimates and standard errors in parentheses. Main effects of sex, age group, level of education, at-risk region, week number of the survey completion, ethnicity, seeking Zika information online, discussing Zika with practitioners, discussing Zika with family and friends, forwarding information online, reading newspapers online and offline, using online news sites, listening to radio online and offline, watching television online and offline, usage frequency of Twitter, and usage frequency of Facebook, were included for the estimations of paths *a* and *b*, while the interaction effects between the mediators and the group variable, sex, and at-risk region, were included for the estimation of paths *b* and *c'*.
*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Table IV

Results of Mediation Analyses of the Unintended-Pregnancy-Probability-Sample of Younger Respondents at Zika-infected Regions.

Mediator	Knowledge															
	Sexually-transmitted				Mosquito-transmitted				Microcephaly				Without noticeable symptoms			
	path a	path b	path c'	Sobel test	path a	path b	pth c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	-0.46 (0.29)	0.11 (0.22)	0.05 (0.28)	-	-0.48 (0.29)	0.15 (0.24)	0.57 (0.32)	-	-0.5 (0.28)	0.15 (0.23)	-0.21 (0.27)	-	-0.5 (0.28)	0.15 (0.23)	-0.21 (0.27)	-
Discussing Zika with practitioners	-2.27 (1.03)*	0.56 (0.35)	0.08 (0.23)	-	-2.34 (1.03)*	0.65 (0.39)	0.28 (0.25)	-	-1.72 (0.74)*	-0.06 (0.35)	-0.2 (0.23)	-	-1.72 (0.74)*	-0.06 (0.35)	-0.2 (0.23)	-
Discussing Zika with family and friends	-0.27 (0.29)	0.42 (0.23)	-0.01 (0.28)	-	-0.23 (0.28)	0.38 (0.25)	0.35 (0.3)	-	-0.19 (0.27)	0.2 (0.23)	-0.2 (0.28)	-	-0.19 (0.27)	0.2 (0.23)	-0.2 (0.28)	-

Mediator	Behavioral intentions and behaviors											
	Change of travel plans				Get vaccinated if available				Taking protective behavior(s)			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	-0.55 (0.33)	-0.35 (0.25)	-0.03 (0.3)	-	-0.38 (0.43)	0.28 (0.32)	-0.1 (0.39)	-	-0.57 (0.33)	0.2 (0.34)	-0.48 (0.47)	-
Discussing Zika with practitioners	-1.19 (0.75)	-0.2 (0.39)	0.31 (0.27)	-	-1.05 (1.17)	0.85 (0.6)	-0.04 (0.34)	-	-1.22 (0.76)	0.78 (0.5)	-0.31 (0.38)	-
Discussing Zika with family and friends	-0.45 (0.33)	-0.06 (0.25)	0.43 (0.31)	-	-0.43 (0.45)	-0.05 (0.34)	-0.17 (0.38)	-	-0.48 (0.34)	0.84 (0.34)**	-0.95 (0.56)	-

Note. Less-educated unmarried black respondents were coded as 1 whereas other respondents were coded as -1. Unstandardized estimates and standard errors in parentheses. Main effects of sex, week number of the survey completion, seeking Zika information online, discussing Zika with practitioners, discussing Zika with family and friends, forwarding information online, reading newspapers online and offline, using online news sites, listening to radio online and offline, watching television online and offline, usage frequency of Twitter, and usage frequency of Facebook, were included for the estimations of paths *a* and *b*, while the interaction effects between the mediators and the group variable and sex were included for the estimation of paths *b* and *c'*.

*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Authorship

Man-pui Sally Chan and Mohsen Farhadloo prepared the first draft of the paper, conducted the literature review, and did the data analysis. Kenneth Winneg and Kathleen Hall Jamieson designed the survey on which the study is based. Dolores Albarracin contributed to the analytic strategy and to paper writing. All authors contributed in editing and revising the paper.

Conflict of Interest

The study is based on a survey designed and conducted by Kathleen Hall Jamieson and Kenneth Winneg of the Annenberg Public Policy Center of the University of Pennsylvania. Two of the authors (Kenneth Winneg and Kathleen Hall Jamieson) are affiliated with the center and no authors has a conflict of interest.

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Appendix A

Table SI

Results of Mediation Analyses of the Unintended-Pregnancy-Probability-Sample of Younger Respondents at Zika-infected Regions By Education Level

Mediator	Knowledge															
	Sexually-transmitted				Mosquito-transmitted				Microcephaly				Without noticeable symptoms			
	path a	path b	path c'	Sobel test	path a	path b	pth c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	0.75 (0.23)***	0.02 (0.23)	-0.19 (0.27)	-	0.56 (0.22)*	0.00 (0.25)	-0.24 (0.28)	-	0.55 (0.22)*	0.27 (0.24)	0.38 (0.28)	-	0.55 (0.22)*	0.27 (0.24)**	0.38 (0.28)	1.01*
Discussing Zika with practitioners	0.31 (0.34)	0.47 (0.39)	0.01 (0.2)	-	0.29 (0.34)	0.68 (0.43)	-0.09 (0.21)	-	0.44 (0.32)	-0.44 (0.39)	-0.06 (0.21)	-	0.44 (0.32)	-0.44 (0.39)	-0.06 (0.21)	-
Discussing Zika with family and friends	0.18 (0.23)	0.47 (0.23)*	0.08 (0.25)	-	0.29 (0.22)	0.51 (0.26)*	0.18 (0.26)	-	0.25 (0.22)	0.36 (0.24)	0.47 (0.26)	-	0.25 (0.22)	0.36 (0.24)	0.47 (0.26)	-

Mediator	Behavioral intentions and behaviors											
	Change of travel plans				Get vaccinated if available				Taking protective behavior(s)			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	0.65 (0.26)*	-0.22 (0.26)	-0.11 (0.3)	-	0.70 (0.37)*	0.31 (0.34)	-0.14 (0.43)	-	0.62 (0.26)*	0.23 (0.36)	0.44 (0.39)	-
Discussing Zika with practitioners	0.21 (0.38)	-0.04 (0.42)	-0.07 (0.23)	-	0.06 (0.67)	1.19 (0.64)	0.03 (0.32)	-	0.33 (0.38)	0.91 (0.53)*	0.52 (0.30)	-
Discussing Zika with family and friends	0.50 (0.25)*	-0.02 (0.26)	0.02 (0.28)	-	0.28 (0.36)	0.06 (0.34)	0.03 (0.37)	-	0.59 (0.26)*	1.01 (0.35)	0.58 (0.39)	-

Note. More-educated respondents were coded as 1 whereas less-educated respondents were coded as -1. Unstandardized estimates and standard errors in parentheses. Main effects of sex, week number of the survey completion, seeking Zika information online, discussing Zika with practitioners, discussing Zika with family and friends, forwarding information online, reading newspapers online and offline, using online news sites, listening to radio online and offline, watching television online and offline, usage frequency of Twitter, and usage frequency of Facebook, were included for the estimations of paths *a* and *b*, while the interaction effects between the mediators and the group variable and sex were included for the estimation of paths *b* and *c'*.

*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Table SII

Results of Mediation Analyses of the Unintended-Pregnancy-Probability-Sample of Younger Respondents at Zika-infected Regions By Black Ethnicity

Mediator	Knowledge															
	Sexually-transmitted				Mosquito-transmitted				Microcephaly				Without noticeable symptoms			
	path a	path b	path c'	Sobel test	path a	path b	pth c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	-0.29 (0.25)	0.10 (0.23)	0.15 (0.25)	-	-0.33 (0.25)	0.18 (0.24)	0.55 (0.28)*	-	-0.40 (0.25)	0.19 (0.23)	-0.12 (0.25)	-	-0.34 (0.25)	0.80 (0.22) ***	-0.22 (0.25)	-
Discussing Zika with practitioners	-1.14 (0.54)*	0.48 (0.36)	0.13 (0.21)	-	-1.17 (0.54)*	0.70 (0.40)	0.29 (0.22)	-	-1.01 (0.49)*	-0.08 (0.36)	-0.23 (0.21)	-	-1.07 (0.49)*	0.29 (0.35)	-0.25 (0.21)	-
Discussing Zika with family and friends	-0.33 (0.25)	0.43 (0.23)	0.14 (0.25)	-	-0.23 (0.25)	0.42 (0.25)	0.41 (0.26)	-	-0.24 (0.24)	0.26 (0.24)	-0.07 (0.25)	-	-0.11 (0.24)	-0.27 (0.23)	-0.34 (0.25)	-

Mediator	Behavioral intentions and behaviors											
	Change of travel plans				Get vaccinated if available				Taking protective behavior(s)			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	-0.35 (0.29)	-0.44 (0.25)	-0.07 (0.28)	-	-0.40 (0.40)	0.35 (0.33)	-0.02 (0.37)	-	-0.36 (0.29)	0.15 (0.35)	-0.34 (0.41)	-
Discussing Zika with practitioners	-1.12 (0.63)	-0.12 (0.39)	0.43 (0.25)	-	-1.54 (1.12)	0.87 (0.60)	-0.1 (0.32)	-	-1.11 (0.63)	0.86 (0.51)*	0.00 (0.32)	-
Discussing Zika with family and friends	-0.32 (0.29)	-0.08 (0.25)	0.40 (0.28)	-	-0.31 (0.4)	0.02 (0.34)	-0.08 (0.36)	-	-0.33 (0.29)	0.88 (0.34)	-0.36 (0.43)	-

Note. Black respondents were coded as 1 whereas non-black respondents were coded as -1. Unstandardized estimates and standard errors in parentheses. Main effects of sex, week number of the survey completion, seeking Zika information online, discussing Zika with practitioners, discussing Zika with family and friends, forwarding information online, reading newspapers online and offline, using online news sites, listening to radio online and offline, watching television online and offline, usage frequency of Twitter, and usage frequency of Facebook, were included for the estimations of paths *a* and *b*, while the interaction effects between the mediators and the group variable and sex were included for the estimation of paths *b* and *c'*.

*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Table SIII

Results of Mediation Analyses of the Unintended-Pregnancy-Probability-Sample of Younger Respondents at Zika-infected Regions By Marital Status

Mediator	Knowledge															
	Sexually-transmitted				Mosquito-transmitted				Microcephaly				Without noticeable symptoms			
	path a	path b	path c'	Sobel test	path a	path b	pth c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	0.49 (0.37)	0.37 (0.60)	0.10 (0.36)	-	0.33 (0.35)	0.06 (0.62)	-0.06 (0.39)	-	0.36 (0.36)	-0.30 (0.60)	-0.35 (0.36)	-	0.37 (0.35)	1.00 (0.59)	0.25 (0.34)	-
Discussing Zika with practitioners	-1.23 (0.41)**	0.10 (0.70)	-0.09 (0.32)	-	-1.22 (0.41)**	0.27 (0.75)	-0.15 (0.34)	-	-1.09 (0.41)*	-0.42 (0.72)	-0.24 (0.33)	-	-1.22 (0.39)**	-1.56 (0.69)*	-0.23 (0.31)	1.83
Discussing Zika with family and friends	-0.04 (0.35)	0.58 (0.60)	0.05 (0.37)	-	0.03 (0.34)	0.29 (0.64)	-0.10 (0.38)	-	-0.03 (0.34)	-0.56 (0.59)	-0.50 (0.38)	-	0.03 (0.34)	-0.46 (0.58)	0.05 (0.34)	-

Mediator	Behavioral intentions and behaviors											
	Change of travel plans				Get vaccinated if available				Taking protective behavior(s)			
	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test	path a	path b	path c'	Sobel test
Seeking Zika information online	0.15 (0.38)	-1.46 (0.76)*	-1.59 (0.52)**	-	0.51 (0.59)	-0.32 (1.02)	-0.32 (0.55)	-	0.13 (0.38)	0.54 (0.82)	0.08 (0.55)	-
Discussing Zika with practitioners	-1.14 (0.43)*	0.05 (0.89)	-0.98 (0.42)*	-	-0.18 (0.96)	15.54 (0.32)***	0.11 (0.49)	-	-1.24 (0.44)**	0.41 (0.91)*	-0.15 (0.47)***	-0.45
Discussing Zika with family and friends	0.17 (0.38)	0.68 (0.82)	-0.80 (0.44)	-	-0.26 (0.54)	0.46 (0.93)	0.10 (0.61)	-	0.10 (0.38)	1.86 (0.88)	0.37 (0.6)	-

Note. Unmarried respondents were coded as 1 whereas married respondents (including previously married) were coded as -1. Unstandardized estimates and standard errors in parentheses. Main effects of sex, week number of the survey completion, seeking Zika information online, discussing Zika with practitioners, discussing Zika with family and friends, forwarding information online, reading newspapers online and offline, using online news sites, listening to radio online and offline, watching television online and offline, usage frequency of Twitter, and usage frequency of Facebook, were included for the estimations of paths *a* and *b*, while the interaction effects between the mediators and the group variable and sex were included for the estimation of paths *b* and *c'*.

*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Supplementary material 1

Table SI

Survey Questions about Knowledge and Behavioral Intentions and Behaviors

Questions	Response values
Knowledge	
Just your best guess. How do scientists think someone can get the Zika virus? By having sexual intercourse with someone who has the Zika virus?	1 = Not likely at all 2 = Not too likely
Just your best guess. How do scientists think someone can get the Zika virus? By being bitten by a mosquito that has already bitten someone who has the Zika virus?	3 = Somewhat likely 4 = Very likely
How accurate is it to say that a pregnant woman who is infected with the Zika virus is more likely to have a baby with an unusually small head and brain?	1 = Not at all accurate 2 = Not too accurate
How accurate is it to say that an individual who has been infected by the Zika virus will know it because the Zika virus always produces noticeable symptoms?	3 = Somewhat accurate 4 = Very accurate
Behavioral intentions and behaviors	
If you planned a trip before you knew about the Zika virus, how likely would it be for you to change your travel plans if you learned that your destination had an outbreak of the Zika virus?	1 = Not likely at all 2 = Not too likely
If there were a vaccine that protected you from getting Zika how likely, if at all, is it that you would get the vaccine?	3 = Somewhat likely 4 = Very likely
In the past three months, have you done anything to protect yourself from getting Zika?	-1 = No 1 = Yes

Table SII

Results of Logistic Regressions of Differences in Knowledge, Behavioral Intentions, and Behaviors for Three Sample Comparisons

Sample	Sexually-transmitted	Mosquito-transmitted	Microcephaly	Noticeable symptoms	Change of travel plans	Get vaccinated if available	Taking protective behaviors
Either current or intended pregnancy (vs. neither)	-0.31(0.06)***	-0.1(0.06)	-0.23 (0.07)***	-0.06 (0.06)	-0.37 (0.07)***	-0.4 (0.10)***	-0.48 (0.08)***
Pregnancy-intention-group (vs. current-pregnancy-group)	-0.15(0.13)	0.06(0.14)	0.03 (0.14)	0.13 (0.13)	-0.42 (0.16)**	0.14 (0.21)	0.14 (0.21)
Less-educated unmarried black respondents (vs. others)	-0.02(0.23)	0.24(0.25)	-0.27 (0.23)	-0.41 (0.23)	0.42 (0.27)	-0.06 (0.33)	-0.57 (0.36)

*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Nationally Representative Telephone Samples – SSRS Omnibus and Custom Studies

1. Coverage: To ensure representativeness, all working cell phone and landline telephone exchanges in the fifty states and the District of Columbia are covered in SSRS's overlapping, dual-frame (cell phone and landline) design. According to the most recent National Health Interview Survey (NHIS), nearly 97% of U.S. adults are reachable by either a cell phone or a landline[1].

2. Covering the cell-phone only population: Currently, nearly half of U.S. adults live in households without a landline connection. To ensure adequate representation of the cell-phone only (CPO), the following two steps are taken:
   (1) The majority of interviews are completed with respondents reached through their cell phones. On the SSRS Omnibus, the current share of respondents interviewed on their cell phones is 60%. Of these, about 60% are CPO. In other words, about 36% of respondents are CPO. On custom studies, the share of respondents reached via cell phone is typically 70% (approximately 40% CPO).
   (2) Weighting by phone usage: Phone status, that is CPO, landline only or dual-user, is included in the post stratification weighting adjustments, based on the most recent NHIS estimates. Currently, this means that in a weighted national sample, about 50% of the sample is CPO.

3. Spanish interviewing: The Hispanic population is the most rapidly-growing ethnic group in the U.S. According to the Census, about one third of the Hispanic population are estimated to speak English less than very well, including some defined as linguistically isolated. To ensure that non-English speaking Hispanics are represented in the sample, about 3%-3.5% of interviews conducted in national surveys are completed in Spanish.

4. Probability-based sampling: To ensure unbiased sampling, both the landline and cell phone sample are generated randomly, so that phone numbers have an equal and known probability of selection (EPSEM). Furthermore, telephone exchanges are stratified by geography, to improve geographic representativeness and pulled in replicates of 100, to reduce sample variance.
   - When reaching a household by dialing a landline number a single respondent is selected through the following selection process: First, interviewers ask to speak with the youngest adult male/female at home. The term "male" appears first for a random half of the cases and "female" for the other randomly selected half. If there are no men/women at home during that time, interviewers ask to speak with the youngest female/male at home.

5. Adjustment for probability of selection: As part of the weighting process, each case is assigned a sample-weight (or baseweight) equal to the inverse of the respondent's

[1] https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201612.pdf

probability of selection. Based on Buskirk and Best (2012)[2], probability of selection is based on respondents' probability of being selected into the landline sample and their probability of selection into the cell phone model:

$$P_{select}=P_{cell}+P_{LL}-P_{cell}*P_{LL}$$

Where P_{select} is probability of selection, P_{cell} is probability of selection into the cell phone frame and P_{LL} is probability of selection into the landline frame.

P_{cell}, in turn is equal to: $F_{cell}*N_{cell}$ and $P_{LL}$is equal to $F_{LL}*N_{LL}/Adults_{HH}$

Where F_{cell} is equal to the number of cell phone numbers selected into the study's sample divided by the total possible cell phone numbers available for sampling, N_{cell} equals the number of cell phones by which a respondent could personally be reached, F_{LL} is equal to the number of landline phone numbers selected into the study's sample divided by the total possible landline numbers available for sampling, N_{LL} equals the number of landlines by which a respondent's household could be reached, and $Adults_{HH}$ is equal to the number of adults living in the respondent's household who could be selected to be interviewed.
The sample-weight is calculated as:

$$1/ P_{select}$$

6. Post-stratification adjustment: The sample weight renders the sample equivalent to a simple random sample. With this weight applied, the sample is weighted to reflect the overall makeup of the known U.S. adult population, based on known population parameters. Using the most recent March supplement of the U.S. Census Bureau's Current Population Survey (CPS), population parameters are calculated for:

    - Age (18-29; 30-49; 50-64; 65 or more) by gender
    - Race/Ethnicity: Hispanic and born in the continental U.S., Hispanic and born outside of the U.S. or in Puerto Rico, non-Hispanic White; non-Hispanic Black; non-Hispanic other.
    - Educational attainment (less than high school graduate; high-school graduate, including non-college technical degrees; some college education, including Associate's Degree; Bachelor's degree or more)
    - Census Region (Northeast; Midwest; South; West)

    In addition, the data are weighted to reflect the distribution of the population along quintiles of population density. All counties in the U.S. are ranked from least dense to most dense and assigned to ranked quintiles of about equal size, based on the most recent

[2] http://www.princetonsurvey.com/filesave/304351_72969BuskirkBest.pdf

Decennial Census. Weighting the sample to population density improves representativeness of the weighted sample by urban, suburban and rural status.

Post-stratification also includes the phone status variable, mentioned above, based on the most recent NHIS estimate.

Weighting is done by iterative proportional fitting, or 'raking', a method is which the data are repeatedly weighted to the parameters until the variance between the weighted sample and the population parameters is zero, or near-zero. [3]

7. Response rate calculation: Response rate is calculated using AAPOR's response rate 3 (RR3)[4]. RR3 is calculated as the number of completed interviews (I) divided by the estimated number of eligible respondents (E). The estimated number of eligible respondents is calculated as:

$$E=(I+P)+(R+NC+O)+e(U_{HH}+U_O)$$

P is partial interviews, R is eligible refusals, NC is eligible non-contacts (where a respondent was identified but no interview completed), O is other eligible cases not completed, U_{HH} are cases where a household was reached but the eligibility of respondents not ascertained, and U_O are other unknown cases where it is unclear whether the number is attached to a household (or cell phone respondent) and whether that respondent is eligible or not.

e is an estimator for the percent of unknown cases estimated to be eligible. In dual frame studies to different e estimators are used for landline and cell phone numbers:

e1 - Estimated Percentage of Screener Eligibility (i.e., the proportion of households known to be eligible at the household-level that are estimated to have an eligible respondent residing there); and e2 = Estimated Percentage of Household Eligibility (i.e., the proportion of cases that are of unknown eligibility at the household-level and it is unknown if an eligible respondent resides there).

[3] Following post-stratification, the weights are truncated, or trimmed, at a range of 0.25 and 4 to reduce the impact of any particular case, and to control the increased variance caused by weighting.

[4] https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions2015_8theditionwithchanges_April2015_logo.pdf