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Zika virus knowledge, attitudes and prevention behaviors among pregnant women in the ZEN cohort study, Colombia, 2017–2018

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Abstract

Background: Zika virus (ZIKV) infection during pregnancy can cause severe birth defects in the fetus and is associated with neurodevelopmental abnormalities in childhood. Our objective was to describe ZIKV knowledge and attitudes among pregnant women in Colombia while ZIKV was circulating and whether they predicted the adoption of behaviors to prevent ZIKV mosquito-borne and sexual transmission.

Methods: We used self-reported data from Zika en Embarazadas y Niños (ZEN), a cohort study of women in early pregnancy across three regions of Colombia during 2017–2018. We used Poisson regression to estimate associations between knowledge, attitudes and previous experience with mosquito-borne infection and preventative behaviors.

Results: Among 1519 women, knowledge of mosquito-borne transmission was high (1480; 97.8%) and 1275 (85.5%) participants were worried about ZIKV infection during pregnancy. The most common preventive behavior was wearing long pants (1355; 89.4%). Regular mosquito

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Ethical approval: The study protocol was approved by the INS Ethics and Methods Committee and the CDC Institutional Review Board. Study procedures were in accordance with the Helsinki Declaration. All participants provided informed consent. Participation was voluntary, and they could choose to opt out of study activities or withdraw at any time.

Supplementary Data

Supplementary data are available at *Transactions* online.

repellent use was uncommon (257; 17.0%). While ZIKV knowledge and attitudes were not associated with the adoption of ZIKV prevention behaviors, previous mosquito-borne infection was associated with increased condom use (prevalence ratio 1.4, 95% CI 1.1 to 1.7).

Conclusions: Participants were well informed about ZIKV transmission and its health consequences. However, whether this knowledge resulted in behavior change is less certain.

Keywords

Colombia; health knowledge attitudes and practice; pregnancy; prevention; Zika virus

Introduction

In February 2016, the WHO declared Zika-associated microcephaly to be a Public Health Emergency of International Concern. The first cluster of Zika virus (ZIKV) cases in Colombia was detected in October 2015, although ZIKV may have been circulating in the population months earlier.[1,2] Through the end of the epidemic in July 2016, >100 000 ZIKV cases were reported, including >18 000 cases in pregnant women, and cases continue to occur today.1 In most people, symptomatic ZIKV infection is typically a mild, self-limiting illness with symptoms that include rash, joint pain and conjunctivitis, but nearly two-thirds of infections are thought to be asymptomatic.[3,4] ZIKV infection during pregnancy, however, can cause a constellation of severe birth defects in the fetus and has also been associated with neurodevelopmental abnormalities in childhood.[5–7]

During the 2015–2016 ZIKV outbreak, public health agencies encouraged people to take preventive measures against mosquito-borne and sexual transmission of ZIKV, particularly before and during pregnancy, to prevent adverse outcomes. These preventive measures included wearing mosquito repellent, wearing clothes that fully covered the arms and legs, using a condom when having sex or not having sex during pregnancy, in addition to reducing mosquito breeding sites and using mosquito nets and screens.[8,9] Some public health agencies, including the Colombian Ministry of Health, also recommended that people delay pregnancy until the end of the outbreak.[10] Public health campaigns in Colombia during the ZIKV outbreak resulted in the widespread understanding that ZIKV was transmitted by the bite of an infected mosquito; there was markedly less awareness that ZIKV could be transmitted sexually despite risk messaging from national and local public health entities.[11–13]

Knowledge of and attitudes towards ZIKV are likely important predictors of the adoption of preventive measures against ZIKV infection in pregnancy, but do not guarantee that women adopt these preventive measures. For example, one study of pregnant women in Colombia found that women tended to avoid wearing mosquito repellent because they disliked the smell, and avoided fully covering their arms and legs because of the hot climate of many Colombian cities where the virus was circulating.[12] However, some of these barriers might be overcome by strong motivations to avoid ZIKV infection.[12] Additional research from Colombia shows that people with a history of ZIKV, chikungunya or dengue virus infection are more likely to use mosquito-preventive behaviors such as fumigating their homes or participating in community clean-up projects, perhaps because their prior experience with

infection is a strong motivator to avoid future infection.[13] With several large chikungunya and dengue outbreaks occurring in Colombia in the years prior to the ZIKV outbreak, [14, 15] women infected in these prior outbreaks may have been primed to adopt preventive measures against mosquito bites when public health messaging around ZIKV began.

Our objective was to understand the knowledge, attitudes and prior mosquito-borne infection experiences among pregnant women in Colombia during ZIKV transmission, and whether they predicted the adoption of ZIKV-protective behaviors during early pregnancy.

Materials and Methods

We used data from the Zika en Embarazadas y Niños (ZEN) study, a collaboration between Colombia's Instituto Nacional de Salud (INS) and the U. S. Centers for Disease Control and Prevention (CDC).[16] ZEN was a prospective cohort study of ZIKV infection among pregnant women aged ≥16 y and enrolled from February 2017 to January 2018. Women in their first trimester of pregnancy were recruited from participating prenatal care clinics in Colombia and followed through their pregnancies and their children's first 18 mo. Thirteen public and private prenatal care clinics in cities in the Colombian departments of Atlántico (Barranquilla and Soledad), Santander (Bucaramanga and Girón) and Valle de Cauca (Buga, Tuluá, Palmira) were selected due to national surveillance data indicating ZIKV circulating in the area, a high volume of pregnant women receiving prenatal care, and clinic and laboratory capacity to conduct study activities. The study was approved by the INS Ethics and Methods Committee and the CDC Institutional Review Board.

The ZEN study methodology has been described in more detail elsewhere.[16] Briefly, participants with confirmed pregnancies were recruited from the waiting rooms of prenatal care clinics by study staff. Potential participants were escorted to a private area, where they received more information about the study and provided informed consent if interested in participating. After consent, study staff read the baseline questionnaire aloud and recorded participants' answers on paper. The baseline questionnaire, completed only upon enrollment, collected information on demographics, medical and reproductive history, and knowledge, attitudes and behaviors related to ZIKV. Questions about ZIKV were either created specifically for the study or adapted from the WHO's ZIKV Knowledge, Attitudes, and Practice Surveys Resource Pack and a telephone survey of ZIKV prevention behaviors conducted by the Puerto Rico Department of Health and CDC.[17, 18] Questions relevant to this manuscript are in the Supplementary Data. Keeping in mind the sensitive nature of the data collected (e.g. sexual behaviors), study staff reminded participants that they could decline to answer any question. Study staff mainly comprised nurses and psychologists. The staff received extensive training from INS and CDC colleagues on all study materials, met regularly with supervisors to discuss challenges and received ongoing study updates and training.

Outcome variables: ZIKV preventive behaviors

Participants were asked at enrollment how frequently they had engaged in four mosquito bite prevention behaviors within the past 7 d ('always', 'some of the time' or 'never'): (1) worn long pants that covered their legs; (2) worn shirts or jackets with long sleeves

that covered their arms; (3) kept their feet and ankles completely covered; and (4) used mosquito repellent. For the analysis, we dichotomized responses as always/sometimes or never engaging in that behavior in the past 7 d; ‘don’t know’, ‘refused’ or missing were categorized as missing.

We also created a behavior index variable indicating if participants did or did not engage in at least two of the four mosquitobite preventive behaviors in the past 7 d. Because most participants wore long pants, we also created a version of the index that included only wearing long sleeves, keeping feet covered and using mosquito repellent.

With respect to the prevention of sexually transmitted ZIKV infection, participants who reported vaginal sex with a man in the past 3 mo were asked how often their male partner used a condom: ‘always’, ‘sometimes’ or ‘never’. This variable was also dichotomized as always/sometimes or never using a condom during sex; ‘don’t know’, ‘refused’ or missing were categorized as missing. Participants who did not report vaginal sex were excluded.

In a sensitivity analysis, we categorized responses as ‘always’ vs ‘some of the time’ or ‘never’ and results were similar (results not shown).

Predictor variables: ZIKV knowledge, attitudes and prior experience with mosquito-borne infections

To assess ZIKV knowledge, participants were asked how likely it was (‘very likely’, ‘somewhat likely’, ‘impossible’, ‘don’t know’) that ZIKV could: (1) be transmitted by the bite of an infected mosquito; (2) be transmitted by condomless vaginal sex with an infected man; (3) be transmitted in utero to a fetus during pregnancy; (4) could cause microcephaly in the fetus; and (5) could cause birth defects in the fetus. Participants were categorized as having this knowledge if they answered very likely or somewhat likely and as not having this knowledge otherwise; ‘refused’ or missing were categorized as missing.

One question assessing ZIKV attitudes and awareness asked participants if they were worried about getting ZIKV during pregnancy (‘very worried’, ‘somewhat worried’, ‘not at all worried’, ‘don’t know’). We categorized participants as being worried if they responded ‘very worried’ or ‘somewhat worried’ and categorized as not worried if they responded ‘not at all worried’ or ‘don’t know’. Participants were also asked if it was possible to get ZIKV in their communities (‘yes’, ‘no’, ‘don’t know’) and if they knew anyone who had had a ZIKV infection (‘yes’, ‘no’, ‘don’t know’). Participants responding ‘yes’ were considered aware or concerned and participants responding ‘no’ or ‘don’t know’ were considered unaware or not concerned. ‘Refused’ or otherwise missing responses were categorized as missing.

To better understand how prior experience with mosquito-borne infections might affect the adoption of ZIKV preventive behaviors, participants were asked if they had ever been diagnosed with yellow fever, dengue or chikungunya (‘yes’, ‘no’, ‘don’t know’). Response options ‘don’t know’, ‘refused’ or missing were categorized as missing. A combined previous mosquito-borne infection measure was created to indicate previous experience when any one of the individual infections was ‘yes’, and no previous experience if all

individual infections were ‘no’. Insufficient data to determine the presence or lack of previous mosquito-borne infection were categorized as missing.

Statistical analysis

All study participants who completed the baseline questionnaire were eligible for the main analysis. Only women who reported having vaginal sex with a man in the past 3 mo were eligible for the analysis of condom use. We first described the prevalence of ZIKV knowledge about transmission and outcomes, attitudes, previous mosquito-borne infections and participants’ preventive behaviors. We presented descriptive results stratified by clinic type (funded privately [n=5] and funded publicly [n=8]) so that ZIKV knowledge, attitudes or prevention behaviors statistics were available separately for each patient population.

For associations between each predictor and the ZIKV prevention behaviors (individual mosquito-preventive behaviors, the two behavior indices and condom use), we used crude and adjusted Poisson regression with robust standard errors to estimate prevalence ratios (PRs) and 95% CIs. Multivariable models were adjusted for maternal age (continuous) and educational attainment (secondary or less, technical or more). We examined results stratified by clinic type; because no effect measure modification was apparent, we treated clinic type as a potential confounder and adjusted for it in our multivariable models. Study data were captured and managed using REDCap (Research Electronic Data Capture, version 7.3.6, Vanderbilt University, Nashville, TN, USA) [19] and hosted at the Instituto Nacional de Salud in Bogotá, Colombia. The analysis was conducted in SAS 9.4 (SAS Institute, Cary, NC, USA).

Results

A total of 1519 pregnant women enrolled in ZEN, all of whom completed the baseline questionnaire, at a median gestational age of 10 wk (IQR: 7, 12). Participants ranged in age from 16 to 46 y and nearly one-half (44.2%) were aged 18–24 y at enrollment. Across all participants, 442 (29.1%) were recruited from private clinics. The results are shown in Table 1.

The demographics of women differed by prenatal clinic type, particularly with respect to socioeconomic indicators. High educational attainment was 25.9% among women recruited from public clinics and 59.4% among those recruited from private clinics. Socioeconomic stratum data (a designation assigned to households by the Colombian government) showed that 92.7% (937/1077) of those recruited from public clinics and 75.1% (317/442) of those from private clinics were in the two lowest strata. The results are presented in Table 1.

ZIKV knowledge, attitudes and prior mosquito-borne infection experience

Knowledge regarding routes of ZIKV transmission was high. Almost all (1480; 97.8%) knew that ZIKV could be transmitted by the bite of an infected mosquito, 1435 (95.2%) knew it could be transmitted in utero from mother to fetus and 1253 (82.8%) knew it could be sexually transmitted. Most women were aware that ZIKV infection during pregnancy could cause microcephaly (1318; 86.9%) and other birth defects (1278; 84.4%) in offspring. Results did not vary by clinic type. The results are presented in Supplementary Table A1.

Although 1275 (85.5%) participants said they were worried about ZIKV infection during pregnancy, fewer were aware that ZIKV was circulating in their community (958; 63.1%); few knew someone who had ZIKV or symptoms of ZIKV (508; 33.7%).

The most common prior mosquito-borne infection reported by participants was chikungunya (520; 34.8%) and almost one-half of participants reported prior mosquito-borne infection (42.6%). The results did not vary by clinic type. The results are presented in Table 2.

ZIKV prevention behaviors

The most common preventive behavior reported was wearing long pants (1355; 89.4%), followed by wearing clothes with long sleeves (1010; 66.7%) and keeping feet and ankles covered (868; 61.0%). Mosquito repellent use was uncommon (257; 17.0%). None of these behaviors differed by clinic type. The majority (1177; 79.2%) of participants reported ≥2 of these behaviors in the past 7 d; excluding wearing long pants, the prevalence dropped to 768 (52.7%). The results are presented in Table 3.

Among the 1409 participants who had vaginal sex with a man in the past 3 mo, 160 (18.7%) reported condom use during that time, with similar prevalence between participants recruited by clinic type (Table 3).

Associations between knowledge, attitudes, prior mosquito-borne infection experience and prevention behaviors

ZIKV knowledge and attitudes did not appear to be associated with the adoption of ZIKV prevention behaviors. However, previous mosquito-borne infection was associated with increased condom use (adjusted prevalence ratio [aPR] 1.4, 95% CI 1.1 to 1.7). Knowledge of ZIKV sexual transmission was not associated with condom use (aPR 0.8, 95% CI 0.6 to 1.1). Results from the crude and adjusted models were similar, as were the results for the two behavior indices. The results are presented in Table 4.

Results for associations with individual mosquito-preventive behaviors are shown in Supplementary Table A2 (long pants, long sleeves, keeping feet and ankles covered, mosquito repellent use). The strongest association was between knowledge of mosquito transmission and the use of mosquito repellents (PR 5.4, 95% CI 0.8 to 37.4).

Discussion

ZEN participants self-reported high levels of knowledge about ZIKV transmission and the consequences of ZIKV infection during pregnancy, and most used ZIKV prevention behaviors within the week prior to study enrollment. However, this knowledge was not associated with ZIKV prevention behaviors.

ZEN participants' ZIKV knowledge was consistent with estimates from studies of pregnant women during and soon after the ZIKV outbreak in other areas of Colombia.[11, 12] Most participants knew about mosquito-borne transmission and its effects on the developing fetus. Knowledge of sexual transmission was lower, as was seen in other studies, although the

majority of ZEN participants (1435; 82.8%) knew ZIKV could be sexually transmitted.[11, 12] Knowledge about emerging infectious diseases, such as ZIKV, would likely be lower than knowledge about diseases that have been in the population longer, such as dengue or chikungunya.[13]

During the informed consent process, study staff members explained some aspects of ZIKV transmission and that infants would be assessed for health problems associated with ZIKV infection (such as microcephaly and neurodevelopmental outcomes). When participants' knowledge of ZIKV was assessed during the baseline visit immediately following informed consent, it is possible that the information they received from study staff was still fresh in their minds, overestimating the extent of their knowledge about ZIKV. This misclassification, if non-differential, may have biased results towards the null. However, our results are in line with previous studies of ZIKV knowledge in Colombia, suggesting that our estimates may still be valid.[11, 12] Information learned during the enrollment study visit would not have affected participants' responses about ZIKV preventive behaviors they engaged in within the prior 7 d.

We found no other estimates of the prevalence of ZIKV-preventive behaviors in Colombia during or after the ZIKV epidemic in pregnant or non-pregnant populations with which we could compare our results. The frequency of mosquito repellent use in the ZEN cohort was substantially lower than among pregnant women in Puerto Rico and Brazil, where one-half wore it daily.[20, 21] Mosquito repellent was expensive in the ZEN study locations and cost could have been a barrier to its regular use.[12] In a study based in Puerto Rico, 29% of pregnant women wore long sleeves and long pants every day or most days.[21] Although ZEN participants frequently wore long pants (89.4%) and long sleeves (66.7%), because the two studies used different measures, it is difficult to compare if these behaviors were similar. About one-fifth of the sexually active ZEN participants used condoms, similar to that reported by pregnant women in Brazil during the ZIKV epidemic but higher than the 6.6% of women reported as actively using condoms in the Colombian general population pre-epidemic.[22–24] The questionnaire did not collect reasons for using or not using condoms.

Our measurement of participants' behaviors had some limitations. First, the question of keeping feet and ankles covered was edited shortly after implementation to improve comprehension. Participants who answered the old version of the question were excluded, which accounts for the relatively large number of missing values for this variable among respondents from public clinics, where recruitment began (Table 3). Second, the ZEN questionnaire asked only about a subset of ZIKV-preventive behaviors. The extent to which additional prevention behaviors (such as burning coils, reducing standing water around the house and reporting mosquito-breeding sites to public health authorities, as sometimes measured in other studies in Latin America) were used in the ZEN population was not measured.[12, 25] If these behaviors had been included in the ZEN study, our results may have differed. Third, recruitment began in February 2017, after the Colombian government declared the ZIKV epidemic over in July 2016. Although ZIKV was still circulating, this announcement could have led to people decreasing or abandoning preventive behaviors they had adopted during the epidemic. However, this study provides insight on behaviors after an epidemic period, which may speak to the sustainability of preventative behaviors

after public attention to ZIKV decreases. Fourth, we did not account for the seasonality of mosquito-preventive behaviors in the analysis. However, there is no strong seasonality of the major mosquito-borne diseases in Colombia, suggesting the presence of mosquitos all year-round.[26] Because recruitment occurred throughout one calendar year (February through January), both the wet and dry seasons were represented among the study population.

We found few associations between ZIKV knowledge, attitudes and experiences and the adoption of ZIKV preventive behaviors. Attitudes related to very specific aspects of health (e.g. worry about ZIKV infection during pregnancy) could be more predictive of behavior change than more general health attitudes, [27] although we found no clear evidence of this in our study. We had no information on other important predictors of behavior change, such as perceived barriers to change and self-efficacy. A 2019 survey of adults in Cali found that people were more likely to adopt behaviors to prevent mosquito bites (e.g. wearing long sleeves) if they had been previously infected with dengue, chikungunya or ZIKV.[13] In our study, although nearly one-half of ZEN participants had a history of chikungunya, dengue or yellow fever, we found that those with prior infections were no more likely to adopt mosquito-preventive behaviors. In addition, repeated occurrences of mosquito-borne disease outbreaks could affect how people react during subsequent outbreaks. During the ZIKV outbreak, a study of Colombian adults found that people were not motivated to change their mosquito bite-prevention behaviors because they had already adopted their chosen preventive behaviors to protect from dengue and chikungunya.[12] A similar result was found in an epidemic of chikungunya in French Guiana: people more consistently maintained mosquito-preventive behaviors over time because of multiple endemic mosquito-borne diseases.[28]

A limitation of our analysis was that there was little variability in our key predictor and behavior variables: 98% and 95% of participants were aware of mosquito and in utero ZIKV transmission, and 89% wore long pants. This lack of variability meant that we were unable to produce precise estimates for associations between predictors and behaviors, despite our overall large sample size. The magnitude of the association between knowledge of mosquito transmission and mosquito repellent use was large (PR=5.4), suggesting that knowledge was a good indicator of behavior; however, the power was too low for us to be confident in the validity of our effect estimates. However, the high knowledge of ZIKV and the high use of preventive behaviors in the cohort suggests that participants were informed about how they could protect themselves from ZIKV infection during pregnancy.

Our analysis focused on individual-level behavior changes because no information was collected in the ZEN questionnaire about community-level interventions or barriers to behavior change. For example, we could quantify from ZEN data that few participants regularly used mosquito repellent. However, conversations between ZEN study staff and participants revealed that participants were eager to use the mosquito repellent provided to them at study enrollment, and in later study visits, participants requested more repellent due to its cost. This example highlights the importance of collecting information on the barriers to behavior change, as this information could inform public health campaigns. Campaigns to provide free or low-cost mosquito repellent to low-income or high-risk populations could facilitate people’s adoption of these preventive behaviors.[25]

Conclusions

Public health interventions to prevent ZIKV infection during pregnancy require a comprehensive strategy, including educational campaigns, messaging around individual behavior changes, community-level intervention (e.g. mosquito abatement efforts) and connecting people with the resources and healthcare needed to support disease prevention efforts. Our analysis demonstrates that ZEN participants were well informed about ZIKV transmission and its health consequences. The extent to which this knowledge resulted in behavior change is less certain. Knowledge without the right resources has suboptimal public health impact.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability:

Data are protected by an Assurance of Confidentiality. Further information about data access can be directed to Diana Valencia (ile9@cdc.gov).

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Table 1.

Characteristics of participants recruited from private and public clinics: ZEN study, Colombia, 2017–2018

	Private clinic (N=442)		Public clinic (N=1077)		Total (N=1519)	
	n	%	n	%	n	%
Age at enrollment (y)						
16–17	20	4. 5	101	9.4	121	8.0
18–24	149	33.7	523	48.6	672	44.2
25–34	225	50.9	386	35.8	611	40.2
≥35	48	10.9	67	6.2	115	7.6
Educational attainment						
Primary or less	26	5.9	220	20.5	246	16.2
Secondary	153	34. 7	577	53.6	730	48.1
Technical	181	41.0	236	21.9	417	27.5
University or more	81	18.4	43	4.0	124	8.2
Missing	1	NA	1	NA	2	NA
Socioeconomic stratum[a]						
Low (level 1 or 2)	317	75.1	937	92.7	1254	87.5
Medium (level 3 or 4)	100	23.7	71	7.0	171	11.9
High (level 5 or 6)	5	1.2	3	0.3	8	0.6
Missing	20	NA	66	NA	86	NA
Study site						
Atlántico	177	40.0	448	41.6	625	41.2
Santander	78	17.7	337	31.3	415	27.3
Valle de Cauca	187	42.3	292	27.1	479	31.5

Abbreviation: NA, not applicable.

[a]Assigned to households by the Colombian government.

Table 2.

Knowledge and attitudes about Zika virus (ZIKV) and experience with other mosquito-borne viruses among pregnant women, by clinic type: ZEN study, Colombia, 2017–2018

	Private clinic (N=442)		Public clinic (N=1077)		Total (N=1519)	
	n	%	n	%	n	%
Worried about getting ZIKV during pregnancy						
Yes	377	86.3	898	85.1	1275	85.5
No	60	13.7	157	14.9	217	14. 5
Missing	5	NA	22	NA	27	NA
Aware ZIKV is circulating in the community						
Yes	301	68.1	657	61.1	958	63.1
No	141	31.9	419	38.9	560	36.9
Missing	0	NA	1	NA	1	NA
Knows someone with a ZIKV infection						
Yes	150	34. 3	358	33.5	508	33.7
No	288	65.7	711	66.5	999	66.3
Missing	4	NA	8	NA	12	NA
Previous chikungunya infection						
Yes	147	33.6	373	35.3	520	34.8
No	291	66.4	684	64. 7	975	65.2
Missing	4	NA	20	NA	24	NA
Previous dengue infection						
Yes	48	11.0	114	10.8	162	10.9
No	387	89.0	944	89.2	1331	89.1
Missing	7	NA	19	NA	26	NA
Previous yellow fever infection						
Yes	2	0.5	16	1.5	18	1.2
No	433	99.5	1043	98.5	1476	98.8
Missing	7	NA	18	NA	25	NA
Previous mosquito-borne infection (chikungunya, dengue or yellow fever)						
Yes	178	41.2	453	43.2	631	42.6
No	254	58.8	596	56.8	850	57.4
Missing	10	NA	28	NA	38	NA

Abbreviation: NA, not applicable.

Table 3.

Preventive behaviors for mosquito-borne and sexual transmission of Zika virus used by pregnant women in the 7 days prior to study enrollment, by clinic type: ZEN study, Colombia, 2017–2018

	Private clinic (N=442)		Public clinic (N=1077)		Total (N=1519)	
	n	%	n	%	n	%
Long pants covering legs						
Always/sometimes	404	91.4	951	88.6	1355	89.4
Never	38	8.6	122	11.4	160	10.6
Missing	0	NA	4	NA	4	NA
Long sleeves covering arms						
Always/sometimes	300	67.9	710	66.2	1010	66.7
Never	142	32.1	363	33.8	505	33.3
Missing	0	NA	4	NA	4	NA
Feet and ankles covered						
Always/sometimes	285	64.8	583	59.2	868	61.0
Never	155	35.2	401	40.8	556	39.0
Missing	2	NA	93	NA	95	NA
Mosquito repellent						
Always/sometimes	81	18.4	176	16.5	257	17.0
Never	360	81.6	891	83.5	1251	83.0
Missing	1	NA	10	NA	11	NA
Behavioral index[a]						
Two or more behaviors	364	82.3	813	77.8	1177	79.2
One or no behaviors	78	17.7	232	22.2	310	20.8
Insufficient data	0	NA	32	NA	32	NA
Behavioral index[a], excluding long pants covering legs						
Two or more behaviors	242	55.1	526	51.6	768	52.7
One or no behaviors	197	44.9	493	48.4	690	47.3
Insufficient data	3	NA	58	NA	61	NA
Condom use[b]						
Always/Sometimes	86	21.1	174	17.7	260	18.7
Never	322	78.9	812	82.3	1134	81.3
Missing	2	NA	13	NA	15	NA

Abbreviation:NA,notapplicable.

[a]Indicates if participant did two or more of the following mosquito-preventative behaviors in the 7 days before interview: wore long pants, wore long sleeves, kept feet and ankles covered, and wore mosquito repellent. Wearing long pants was excluded in a second analysis.

[b]Among participants who reported vaginal sex with a man within the past 3 mo (n = 1409).

Table 4.

Crude and adjusted[a] associations between ZIKV knowledge, attitudes and experience with mosquito-borne infection and engagement in ZIKV-preventive behaviors: ZEN study, Colombia, 2017–2018

	Crude prevalence ratio (95% CI)			Adjusted prevalence ratio[a] (95% CI)		
	Behavior index[b]	Behaviorindex[b] excluding long pants	Condomuse[c]	Behaviorindex[b]	Behaviorindex[b] excluding long pants	Condomuse[c]
Knowledge of mosquito transmission						
Yes	1.2 (1.0 to 1.6)	1.4 (0.9 to 2.1)	1.7 (0.6 to 4.9)	1.2 (1.0 to 1.6)	1.3 (0.9 to 2.1)	1.6 (0.6 to 4.8)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Knowledge of in utero transmission						
Yes	1.1 (1.0 to 1.3)	1.1 (0.8 to 1.3)	1.4 (0.7 to 2.8)	1.1 (1.0 to 1.3)	1.0 (0.8 to 1.3)	1.4 (0.7 to 2.8)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Knowledge of ZIKV sexual transmission						
Yes	1.0 (0.9 to 1.1)	1.0 (0.8 to 1.1)	0.8 (0.6 to 1.1)	1.0 (0.9 to 1.1)	1.0 (0.8 to 1.1)	0.8 (0.6 to 1.1)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Knowledge that ZIKV causes microcephaly						
Yes	1.0 (0.9 to 1.1)	0.9 (0.8 to 1.1)	0.9 (0.6 to 1.2)	1.0 (0.9 to 1.1)	0.9 (0.8 to 1.0)	0.9 (0.6 to 1.2)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Knowledge that ZIKV causes other birth defects						
Yes	1.0 (1.0 to 1.1)	1.1 (1.0 to 1.3)	1.1 (0.8 to 1.5)	1.0 (1.0 to 1.1)	1.1 (0.9 to 1.3)	1.1 (0.8 to 1.4)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Aware ZIKV is circulating in the community						
Yes	1.0 (1.0 to 1.1)	1.0 (0.9 to 1.1)	0.9 (0.7 to 1.2)	1.0 (0.9 to 1.0)	1.0 (0.9 to 1.1)	0.9 (0.7 to 1.2)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Knows someone with ZIKV infection						
Yes	1.0 (0.9 to 1.0)	0.9 (0.8 to 1.0)	1.1 (0.9 to 1.4)	0.9 (0.9 to 1.0)	0.9 (0.8 to 1.0)	1.1 (0.9 to 1.4)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Worries about getting ZIKV during pregnancy						
Yes	1.0 (0.9 to 1.1)	1.1 (1.0 to 1.3)	1.5 (1.0 to 2.1)	1.0 (0.9 to 1.1)	1.1 (0.9 to 1.3)	1.5 (1.0 to 2.1)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Previous mosquito-borne infection (chikungunya, dengue or yellow fever)						
Yes	1.0 (1.0 to 1.1)	1.0 (0.9 to 1.1)	1.4 (1.1 to 1.7) *	1.0 (1.0 to 1.1)	1.0 (0.9 to 1.1)	1.4 (1.1 to 1.7) *
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Abbreviations: Ref., reference group; ZIKV, Zika virus.

[a] Adjusted for clinic type, maternal age and maternal educational attainment.

[b] Indicates if participant did two or more of the following mosquito-preventative behaviors in the 7 d before interview: wore long pants, wore long sleeves, kept feet and ankles covered and wore mosquito repellent. Wearing long pants was excluded in a second analysis.

[c] Among participants who reported vaginal sex with a man within the past 3 mo (n=1409).

* Indicates statistical significance.