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P R Health Sci J. Author manuscript; available in PMC 2023 December 01.

Published in final edited form as:
P R Health Sci J. 2022 December ; 41(4): 202–209.

Infant Receipt of Health Care Services during the 2016−2017 Zika Virus Outbreak in Puerto Rico

Denise V. D'Angelo, MPH[*], **Ruben A. Smith, PhD, MS**[*], **Beatriz Salvesen von Essen, MPH**[*], **Katherine Kortsmit, PhD, MPH**[*], **Sascha Ellington, PhD**[*], **Romeo Galang, MD, MPH**[*], **Wanda Hernández-Virella, MPH**[†], **Holly Shulman, MA**[*], **Manuel Vargas-Bernal, MD, MPH**[†], **Lee Warner, PhD**[*]

[*]Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia;

[†]Division of Maternal, Child, and Adolescent Health, Puerto Rico Department of Health, San Juan, Puerto Rico

Abstract

Objective: To assess the receipt of health care services among live-born infants of women with and without evidence of Zika virus (ZIKV) infection while pregnant during the 2016–2017 ZIKV outbreak in Puerto Rico.

Methods: We used data from the Pregnancy Risk Assessment Monitoring System–Zika Postpartum Emergency Response study telephone surveys to examine maternal reports of the receipt of health care services by infants born in Puerto Rico from August through December 2016 and November through December 2017. Evidence of ZIKV infection was ascertained from the infant's birth certificate or was self-reported in the survey.

Results: Fourteen percent of women in 2016 and 9% in 2017 had evidence of ZIKV infection during pregnancy. Most infants of women with evidence of ZIKV received the recommended health care services in 2016 and 2017, respectively, including a hearing test (91% vs. 92%), developmental assessment (90% vs. 92%), and an eye exam (74% vs. 70%); fewer received a head scan (45% vs. 36%) and evaluation for physical therapy (17% vs. 10%). From 2016 to 2017, the proportion of infants having a personal doctor increased for all infants; for infants of women without evidence of ZIKV infection, receiving hearing, developmental, and eye assessments increased.

Conclusion: Most infants of women with evidence of ZIKV infection during pregnancy received the recommended hearing and developmental assessments during the ZIKV outbreak. Experiences with increasing service capacity during the ZIKV outbreak can be evaluated to inform the response to future emergencies that affect maternal and child health.

Address correspondence to: Denise D'Angelo, MPH, Division of Reproductive Health, Centers for Disease Control and Prevention, 4770 Buford Hwy. NE, MS F-74, Atlanta, GA 30341. DDAngelo@cdc.gov.

The authors have no conflicts of interest to disclose. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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Resumen

Evaluar los servicios médicos recibidos por infantes nacidos vivos en Puerto Rico durante la epidemia del Zika (2016–2017) por estatus de infección maternal.

Analizamos datos del Sistema de Evaluación del Riesgo en el Embarazo-Respuesta de Emergencia ante el Zika en el Periodo Postparto para comparar los servicios médicos recibidos por infantes nacidos en agosto-diciembre del 2016 y noviembrediciembre del 2017. Evaluamos datos del certificado de nacimiento y la encuesta para determinar el estatus de infección durante el embarazo.

El 14% de las madres en el 2016 y 9% en el 2017 tuvieron evidencia de infección de Zika en el embarazo. Durante el 2016 y 2017, respectivamente, la mayoría de los infantes nacidos de madres con evidencia de infección recibieron servicios recomendados como evaluaciones auditivas (91% vs. 92%), del desarrollo (90% vs. 92%) y oftalmológicas (74% vs. 70%); menos de la mitad recibieron ultrasonidos de la cabeza (45% y 36%) o evaluaciones para terapia física (17% vs. 10%). Comparando 2016 y 2017, observamos un aumento en el número de infantes que tenían un médico personal para ambos grupos; también observamos aumentos en evaluaciones auditivas, del desarrollo y oftalmológicas para infantes de madres sin evidencia de infección.

Durante la epidemia del Zika, la mayoría de los infantes nacidos de madres que tuvieron Zika durante el embarazo recibieron las evaluaciones recomendadas (audición y desarrollo). Evaluar las experiencias asociadas al aumento en servicios durante la epidemia podría ayudar a responder a futuras emergencias que pongan en riesgo la salud materno-infantil.

Keywords

Zika; Infant health care; PRAMS; Puerto Rico

During the Zika virus (ZIKV) outbreak in Puerto Rico (2016–2017), there were over 4,000 cases of pregnant women with laboratory evidence of possible ZIKV infection (symptomatic and asymptomatic) (1). Infection with ZIKV during pregnancy can result in microcephaly, brain abnormalities, eye abnormalities, and other severe birth defects in the infant (2–4). Interim guidance directed at health care personnel who care for infants possibly having congenital ZIKV infection was published by the Centers for Disease Control and Prevention (CDC) in January 2016 and an Administrative Order (Orden Administrativo Número 360) was issued by the Puerto Rico Department of Health (PRDH) in August 2016 (5–7). Specifically, the CDC recommended that all infants born to mothers who show laboratory evidence of Zika infection during their pregnancies be evaluated (including an automated auditory brainstem response test) at birth and all subsequent well-child visits. Ideally, the evaluation would consist of a comprehensive physical exam, vision screening appropriate to age, developmental monitoring, and screening with validated screening tools (6). It is also recommended that these infants receive a head ultrasound and a comprehensive ophthalmologic exam by the age of 1 month. Consultations with specialists in infectious disease, neurology, ophthalmology, and clinical genetics and services aimed at early intervention and development and family support should be considered. Additional consultations (i.e., endocrinology, lactation, nutrition,

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gastroenterology, speech or occupational therapy, physical therapy, and pulmonology or otolaryngology) were recommended based on the clinical findings of the infant (6). The PRDH adopted the CDC's guidance for health care providers in Puerto Rico (7).

During the outbreak, funding became available to enhance primary care and long-term support services for ZIKV-affected infants in Puerto Rico (8–10). This analysis used population-based data from the Pregnancy Risk Assessment Monitoring System–Zika Postpartum Emergency Response (PRAMS-ZPER) study to assess the special needs status of infants born to women with and without evidence of ZIKV infection during pregnancy, as well as the receipt of recommended health care services by those infants, the usual place of service for the infants, and differences in these indicators from 2016 to 2017.

Materials and Methods

The PRDH and CDC partnered to conduct the PRAMS-ZPER study, a 2-phased, population-based study that consisted of administering surveys designed to collect information from a random sample of women with recent live births. The survey assessed maternal experiences and behaviors related to the detection and prevention of ZIKV infection during pregnancy, postpartum experiences, and infant health. Sampled women were surveyed in their hospital rooms 24 to 36 hours after giving birth to a live infant. The study was not limited to women with laboratory-confirmed evidence of ZIKV infection. The study used a cluster sampling methodology to randomly select a sample of all women who had live births during the study periods. The sample in phase 1 of the study represented 99.8% of the live births during the study period, August through December 2016; a telephone follow-up survey was conducted from June through July 2017 (7−9 months postpartum). The sample in phase 2 of the study represented 94.2% of the live births during the study period, November through December 2017; a telephone follow-up survey was conducted from February through April 2018 (3−4 months postpartum). For the original hospital-based sample, hospitals were eligible to participate if they had delivered 100 or more births in the prior year, according to the vital records data from Puerto Rico's Demographic Registry. The telephone follow-up survey was conducted among a subset of participants who had responded to the hospital-based survey. Additional details about the study have been described elsewhere (11). The data were weighted to account for the complex sampling design and were linked with birth certificate information obtained from Puerto Rico's Demographic Registry. The study protocol and questionnaires* were approved by the institutional review boards of the CDC and the University of Puerto Rico, Medical Sciences Campus.

Among the women eligible to participate in the telephone survey during phase 1 (n = 1535) and phase 2 (n = 1485), the response rates were 77% and 83%, respectively. Access to birth certificate records to locate phone numbers and having interacted with telephone respondents a few months prior during the hospital interviews may have contributed to the high response rates for the telephone surveys.

We used a broad approach to identifying ZIKV infection. A woman was categorized as having ZIKV infection during pregnancy if infection was reported on any of the following sources: the birth certificate of the woman's infant, self-reported by the woman during the

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in-hospital survey, or self-reported during the telephone follow-up survey. In 2016, Puerto Rico's Demographic Registry received emergency-response funding to add a field to the birth certificate to capture the presence of ZIKV infection. For the PRAMS-ZPER phone surveys in both years, a question was included that was used to ascertain the presence of ZIKV infection during pregnancy: "Since your new baby was born, has a doctor, nurse, or other health care worker told you that your new baby was infected with Zika virus during your pregnancy?"

Of the respondents, 23 women were not asked the questions about Zika infant health status or receipt of care; of these women, 9 reported their infants had died or were not residing with them at the time of the interview, and 14 did not provide information on their infant's vital and residential status. For the remaining respondents with available information, we categorized an infant as having a special need if the mother reported that the infant had 1 or more of the following health conditions that were asked about on the survey: hearing problems, vision problems, poor weight gain, feeding difficulties, smaller-than-normal head size, muscle weakness, deformities of the feet, or convulsions. Each woman was asked whether her baby had received any of the following services: a scan or ultrasound of his or her head—for example, a CT scan or an MRI—a hearing test, an eye exam, an assessment of how the baby was developing, an evaluation for physical therapy, or assistance from a nutritionist. We examined the usual place of care for the infant. A place of care could be a private doctor's office, a health department clinic, a regional pediatric center, or some other location. For the "other location" category, we combined "hospital outpatient clinic," "hospital emergency room," "other health clinic," and "other non-specified." The survey questions are found in the Supplemental Table, and the surveys (in Spanish and in English) can be accessed online at https://www.cdc.gov/prams/special-projects/zika/index.htm

Weighted percentages and 95% confidence intervals (CIs) were calculated. For each year, chi-squared tests were used to identify significant differences ($P < .05$) between women with and without evidence of ZIKV infection during their pregnancy. Differences in the receipt of services between 2016 and 2017 were ascertained using 95% CI estimates of the weighted percents. This typically conservative approach might fail to note differences between estimates more often than formal statistical testing. An overlap between CIs does not necessarily mean that there is no statistical difference between estimates.

Results

Among respondents whose infants were born in 2016, 213 (weighted % = 13.6) had evidence of ZIKV infection during their pregnancy; among respondents whose infants were born in 2017, 111 (weighted % = 9.0) had evidence of ZIKV infection during their pregnancy. For both the 2016 and the 2017 births, over half of respondents were aged 25 years or older, had more than a high school education, were unmarried, and reported that they had Medicaid or public health insurance to pay for their delivery (Table 1).

Among respondents who gave birth in 2016, 3.8% reported having an infant with a health condition or conditions, and were categorized as having a special need (Table 2). Of the women who had evidence of ZIKV infection during their pregnancy, 6.3% had an infant

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with a special need; of those with no evidence of ZIKV infection during their pregnancy, 3.4% had a child with a special need. Significantly higher proportions of women with evidence of ZIKV infection during pregnancy than women without reported that their infants received head scans (44.6% vs. 10.0%), hearing tests (90.8% vs. 83.6%), eye exams (73.7% vs. 41.6%), developmental assessments (89.7% vs. 81.7%), and evaluations for physical therapy (17.4% vs. 7.2%) (Table 2). Of the infants born to respondents in 2017, 3.5% were categorized as having a special need. The sample size was too small to assess differences by ZIKV infection status. Significant differences in the receipt of specific health care services were observed between the children of women with and without evidence of ZIKV infection during pregnancy; 36.0% of the former (compared with 9.8% of the latter) received a head scan, while 69.9% of the former (compared with 58.7% of the latter) received an eye exam (Table 2).

Slightly more than half (53.6%) of the women who gave birth in 2016 reported taking their infant to a private doctor's office; however, by ZIKV infection status, a smaller proportion of women with evidence of ZIKV infection during pregnancy than women without reported taking their infant to a private doctor's office (43.4% vs. 55.2%). In contrast, a larger proportion of women with evidence of ZIKV infection during pregnancy than women without reported usually taking their infants to regional pediatric centers for health care services (9.6% vs. 3.0%). Among the women who gave birth in 2017, the infant's usual place for receiving health care services did not differ by maternal ZIKV infection status. Overall, in 2017, the most commonly reported usual place for infant care was a private doctor's office (54.7%) followed by a health department clinic (33.0%) and a regional pediatric center (4.5%). In addition, there was an increase from 2016 to 2017 in the percentage of infants having a personal doctor (82.9% to 92.8%) (Table 3).

Overall, there was a statistically significant increase in the reports of infants receiving a hearing test (84.5% to 89.8%), an eye exam (46.0% to 59.7%), and a developmental assessment (82.8% to 88.3%) from 2016 to 2017. However, for the other services, such increases were seen only in the infants of women without evidence of ZIKV during pregnancy (Table 2). Report of assistance from a nutritionist declined between the 2 years for women with and without evidence of ZIKV infection (Table 2).

Discussion

In 2016, during the height of the Zika outbreak in Puerto Rico, we found that about 1 in 7 women had evidence of ZIKV infection during their pregnancies. In our study, the measures for ZIKV infection status and special health care needs differed from those of other studies. Nevertheless, our finding that 6.3% of the Zika-infected mothers reported (in 2016) that their newborns had special needs was similar to other studies which have estimated that 5 to 10% of infants exposed to ZIKV infection during pregnancy are born with associated birth defects (12–14).

The CDC interim guidance was published for health care providers on the care and services recommended for infants with possible congenital Zika infection or with clinical findings consistent with congenital Zika infection (6). In our study, while most of the women with

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evidence of ZIKV infection during pregnancy reported that their infants had received the recommended hearing tests, eye exams, and developmental assessments, fewer than half reported that their infants had received head scans.

These results are similar to those reported by the US Zika Pregnancy and Infant Registry (USZPIR), a surveillance system that monitors pregnancy and infant/child outcomes among pregnancies with laboratory evidence of confirmed or possible ZIKV infection (15). The data are abstracted from prenatal, birth hospitalization, pediatric, and specialty care medical records using standardized methods (15). According to the USZPIR data for infants born in US territories or freely associated states before February 1, 2017, who had reached 1 year of age by February 1, 2018, and who had follow-up care that was reported to the USZPIR by June 1, 2018, 76% of these infants had received developmental screenings or evaluations, and 60% had had postnatal neuroimaging (15). Our findings indicated a higher percentage of hearing screenings (91% in 2016 and 92% in 2017) compared with USZPIR, which found that 48% of children had had a hearing screen by automated auditory brainstem response (ABR) or had received an audiologic evaluation by diagnostic ABR. In addition, we found a higher proportion of infants in our study received eye exams (around 70% in both years) than those described by the USZPIR, which reported that 36% had had ophthalmologic evaluations (15).

Resources were made available to the PRDH to identify and provide services to affected infants. For example, funding from the US Health Resources and Services Administration was provided to expand primary care services to help increase screening, strengthen workforce capacity, improve health information and telehealth technology, and provide families impacted by Zika with support services (8–10). Regional pediatric centers and health department clinics provided infants with low-cost care during the ZIKV outbreak (8–10). The Children with Special Health Care Needs program of the PRDH was funded to provide and coordinate care for families impacted by Zika (16). The services were provided at the regional pediatric centers, which expanded available services to provide the recommended care for Zika-affected infants at a single location (9,10). According to our findings, the infants born in 2016 to women with evidence of ZIKV infection during pregnancy were seen more frequently at regional pediatric centers than were the infants born of non-Zika-infected mothers in the same time period, which is likely due to the enhanced resources mentioned above. However, most women with evidence of ZIKV infection during pregnancy reported usually taking their infants to a private doctor's office or to a health department clinic during both 2016 and 2017.

In 2017, differences in the receipt of specific health care services by infants of women with and without evidence of ZIKV infection during pregnancy were observed just for the receipt of head scans and eye exams. Because head ultrasounds and ophthalmologic exams were recommended only for the infants of mothers with laboratory evidence of possible ZIKV infection during pregnancy, this difference can be expected. In addition, from 2016 to 2017, the proportion of women reporting that their infants had a personal doctor and had received recommended services such as hearing and eye exams increased overall. These results appear to be driven by an increased report of these services for infants born to women without evidence of ZIKV infection during pregnancy. Although pre-ZIKV outbreak

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practices were not assessed, these findings suggest that the enhancements implemented throughout the response to the ZIKV outbreak may have had an overall positive impact on the use of routine and recommended health care services by infants throughout Puerto Rico, and these improvements were sustained through 2017.

Our findings are subject to several limitations, most notably, the information on the services received was self-reported and may be subject to recall or social-desirability bias. Secondly, due to the hospital-based sampling methodology used for the PRAMS-ZPER survey, women who gave birth at home were not included in our study. Given the systematic referral of women with evidence of Zika infection during pregnancy, it can be expected that there would be a higher report of their infants having received services. We were also limited in assessing the receipt of services by infants with special needs due to the small sample size; therefore, we focused our analysis on estimating the prevalence of the receipt of services by infants of women for whom an assessment was recommended due to their ZIKV infection status during pregnancy. The data were weighted to represent births to women in the study period (August through December of 2016 and November through December of 2017), not the entire year for 2016 or 2017. Additionally, ZIKV infection during pregnancy was based on survey responses and birth certificate data, but was not confirmed by laboratory or medical records. Likewise, infant special needs status was based on survey responses and not confirmed by medical records. The health conditions assessed on the survey could apply to multiple conditions. The case definitions and terms used in this analysis are for surveillance purposes only, not for clinical purposes. Telephone interviews were conducted later (7–9 months postpartum) in 2016 compared with 2017 (3–4 months postpartum), which may have influenced recall accuracy. Although most of the services evaluated are recommended to occur shortly after delivery, the exact timing of receiving these services could not be determined, nor could the specific services that were received be differentiated from standard newborn screening. In addition, information collected for surveillance by the PRAMS-ZPER survey cannot be precisely aligned with the exact recommendation or screening conducted. For example, a respondent may not know whether the hearing test performed for her infant was an ABR screening test (vs. another hearing test method) or whether her infant received a comprehensive eye exam by an ophthalmologist (vs. a general eye exam by a pediatrician). Some services, such as physical therapy or seeing a nutritionist, were only recommended based on clinical assessment. In addition, the respondents may not have distinguished between health department clinics and regional pediatric centers as locations for care. Finally, women who gave birth in 2017 faced unique challenges in the aftermath of hurricanes Irma and Maria in Puerto Rico (e.g., clinic closures, transportation challenges), which may have impacted not only their postpartum experiences but also their access to services.

The evaluation of infants is essential for ensuring early detection of possible special needs and early referral to intervention services (17–20). Infants with Zika infection were a newly emerging population of individuals with special needs in Puerto Rico during the outbreak. Assessing the response to serving these children can guide future work. In this study, most of the infants received the recommended services. The successes and barriers associated with the ability to scale up, increase capacity, and provide broad access to recommended health care services for infants affected by ZIKV during the outbreak can be evaluated to

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inform programs and decision-making during future public health emergencies that may impact maternal and child health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Characteristics of women with a live birth in Puerto Rico in 2016 and 2017, by Zika infection status.

	2016 Births							2017 Births						
	Maternal Zika Infection Status						Chi-square P value	Maternal Zika Infection Status						Chi-square P value
	Total (n = 1,176)		No (n = 963)		Yes (n = 213)			Total (n = 1,230)		No (n = 1,119)		Yes (n = 111)		
Characteristic	n†	%◊ (95% CI)	n†	%◊ (95% CI)	n†	%◊ (95% CI)		n†	%◊ (95% CI)	n†	%◊ (95% CI)	n†	%◊ (95% CI)	
Age, years														
<20	113	9.5 (8.2, 11.1)	83	8.6 (7.2, 10.3)	30	15.3 (11.3, 20.5)	.0089	129	10.3 (9.0, 11.8)	117	10.3 (8.9, 11.8)	12	10.9 (7.2, 16.1)	.5836
20–24	378	31.9 (29.5, 34.4)	302	31.2 (28.8, 33.8)	76	36.0 (29.8, 42.6)		387	31.3 (29.2, 33.4)	353	31.4 (29.2, 33.7)	34	29.9 (23.8, 36.9)	
25–34	545	46.9 (44.3, 49.5)	456	48.0 (45.2, 50.8)	89	40.2 (34.2, 46.5)		556	45.4 (43.2, 47.5)	502	45.0 (42.8, 47.3)	54	49.0 (41.8, 56.2)	
≥35	127	11.6 (10.0, 13.5)	110	12.1 (10.3, 14.2)	17	8.5 (5.5, 13.1)		158	13.0 (11.6, 14.6)	147	13.3 (11.8, 14.9)	11	10.2 (6.4, 15.9)	
Education														
<High school	64	5.5 (4.4, 6.9)	49	5.2 (4.0, 6.7)	15	7.7 (4.8, 12.3)	.0017	80	6.7 (5.6, 7.9)	73	6.7 (5.6, 8.1)	7	6.1 (3.6, 10.2)	.1928
High school	280	23.2 (21.1, 25.4)	214	21.8 (19.6, 24.1)	66	32.5 (26.5, 39.1)		258	21.3 (19.5, 23.2)	229	20.7 (18.9, 22.7)	29	27.4 (21.0, 34.8)	
>High school	827	71.3 (69.0, 73.5)	697	73.0 (70.5, 75.4)	130	59.8 (53.2, 66.0)		875	72.0 (69.9, 74.0)	801	72.6 (70.4, 74.6)	74	66.5 (59.2, 73.1)	
Marital status														
Married	499	42.7 (40.2, 45.3)	429	44.3 (41.5, 47.2)	70	32.5 (26.5, 39.1)	.0015	472	39.0 (36.9, 41.2)	434	39.4 (37.2, 41.7)	38	34.8 (28.6, 41.6)	.1897
Not married	677	57.3 (54.7, 59.8)	534	55.7 (52.8, 58.5)	143	67.5 (60.9, 73.5)		748	61.0 (58.8, 63.1)	675	60.6 (58.3, 62.8)	73	65.2 (58.4, 71.4)	
Health insurance for delivery														
Private	358	32.5 (30.1, 35.0)	310	33.5 (30.9, 36.3)	48	25.8 (20.4, 32.0)	.0693	383	31.2 (29.4, 33.1)	351	31.5 (29.6, 33.5)	32	28.6 (22.9, 35.1)	-
Medicaid/public	798	66.4 (63.9, 68.8)	637	65.3 (62.5, 68.0)	161	73.1 (66.8, 78.6)		824	67.2 (65.3, 69.1)	745	66.8 (64.7, 68.8)	79	71.4 (64.9, 77.1)	
Other/none	14	1.2 (0.7, 1.8)	11	1.2 (0.7, 1.9)	¶	¶		18	1.6 (1.1, 2.2)	18	1.7 (1.2, 2.4)	¶	¶	
Region of residence£														
East	255	22.9 (21.0, 24.9)	214	23.2 (21.1, 25.4)	41	20.9 (15.9, 27.0)	.0107	309	25.5 (23.7, 27.4)	286	25.9 (24.1, 27.9)	23	21.2 (15.7, 27.9)	.3082

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	2016 Births							2017 Births						
	Maternal Zika Infection Status						Chi-square P value	Maternal Zika Infection Status						Chi-square P value
	Total (n = 1,176)		No (n = 963)		Yes (n = 213)			Total (n = 1,230)		No (n = 1,119)		Yes (n = 111)		
Characteristic	**n**[†]	**%**[◊] **(95% CI)**	**n**[†]	**%**[◊] **(95% CI)**	**n**[†]	**%**[◊] **(95% CI)**		**n**[†]	**%**[◊] **(95% CI)**	**n**[†]	**%**[◊] **(95% CI)**	**n**[†]	**%** [◊] **(95% CI)**	
Central	148	12.5 (11.1, 14.0)	125	12.9 (11.3, 14.7)	23	9.7 (6.8, 13.8)		128	10.2 (9.1, 11.4)	119	10.4 (9.2, 11.7)	9	8.3 (5.1, 13.2)	
North	459	41.0 (38.8, 43.4)	381	41.1 (38.6, 43.7)	78	40.6 (34.5, 47.0)		488	38.6 (36.5, 40.7)	445	38.6 (36.4, 40.9)	43	37.6 (30.6, 45.2)	
South	170	13.4 (12.0, 14.8)	129	12.1 (10.7, 13.8)	41	21.1 (16.5, 26.7)		169	14.9 (13.5, 16.4)	150	14.5 (13.0, 16.1)	19	18.6 (13.1, 25.6)	
West	142	10.2 (9.1, 11.5)	112	10.6 (9.3, 12.1)	30	7.7 (5.4, 10.7)		127	10.8 (9.6, 12.1)	111	10.5 (9.2, 11.9)	16	14.3 (9.6, 20.8)	

[†]Unweighted sample size.

Note: Totals may not add up to the indicated overall unweighted sample size due to missing values and/or data that are not shown.

[◊]Weighted percentage.

[‡]P values are based on the Wald chi-square test of difference of distributions: Zika-exposed moms vs. non-Zika-exposed moms in each year.

[¶]Relative standard error > 50% or with standard error equal to zero; data not shown – estimates not reliable.

[£]Regions are defined as follows: East region: Arroyo, Caguas, Canóvanas, Carolina, Ceiba, Fajardo, Gurabo, Humacao, Juncos, Las Piedras, Loíza, Luquillo, Maunabo, Naguabo, Patillas, Río Grande, San Lorenzo, Trujillo Alto, Vieques, and Yabucoa.

Central region: Adjuntas, Aguas Buenas, Aibonito, Barranquitas, Cayey, Ciales, Cidra, Comerio, Jayuya, Lares, Las Marías, Maricao, Naranjito, Orocovis, and Utuado. North region: Arecibo, Barceloneta, Bayamón, Camuy, Cataño, Corozal, Dorado, Florida, Guaynabo, Hatillo, Isabela, Manatí, Morovis, Quebradillas, San Juan, San Sebastián, Toa Alta, Toa Baja, Vega Alta, and Vega Baja. South region: Coamo, Guayama, Guayanilla, Juana Díaz, Peñuelas, Ponce, Salinas, Santa Isabel, Villalba, and Yauco. West region: Aguada, Aguadilla, Añasco, Cabo Rojo, Guánica, Hormigueros, Lajas, Mayagüez, Moca, Rincón, Sabana Grande, and San Germán.

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Table 2.

Infant special needs and receipt of health care services reported by mothers of live-born infant in Puerto Rico in 2016 and 2017, by maternal Zika infection status.

	2016 Births							2017 Births						
	Maternal Zika Infection Status							Maternal Zika Infection Status						
	Total (n = 1,176)		No (n = 963)		Yes (n = 213)		Chi-square P value	Total (n = 1,230)		No (n = 1,119)		Yes (n = 111)		Chi-square P value
Characteristic	n†	%◊ (95% CI)	n†	%◊ (95% CI)	n†	%◊ (95% CI)		n†	%◊ (95% CI)	n†	%◊ (95% CI)	n†	%◊ (95% CI)	
Any special need*	47	3.8 (2.9, 4.9)	31	3.4 (2.5, 4.6)	16	6.3 (4.0, 9.7)	.0579	43	3.5 (2.8, 4.3)	41	3.6 (2.9, 4.5)	¶	¶	.1384
Received head scan	184	14.6 (13.0, 16.4)	95	10.0 (8.4, 11.7)	89	44.6 (38.4, 50.9)	.0000	146	12.2 (10.9, 13.7)	106	9.8 (8.6, 11.3)	40	36.0 (29.7, 42.9)	.0000
Received hearing test	981	84.5 (82.6, 86.3)	790	83.6 (81.4, 85.5)	191	90.8 (86.1, 93.9)	.0018	1,094	89.8 (88.4, 91.1)	994	89.6 (88.1, 91.0)	100	92.1 (87.3, 95.2)	.2322
Received eye exam	525	46.0 (43.4, 48.7)	377	41.6 (38.8, 44.5)	148	73.7 (67.8, 78.9)	.0000	681	59.7 (57.5, 61.9)	606	58.7 (56.3, 61.1)	75	69.6 (62.4, 75.9)	.0039
Received developmental assessment	964	82.8 (80.6, 84.8)	778	81.7 (79.3, 83.9)	186	89.7 (84.7, 93.1)	.0008	1,072	88.3 (86.8, 89.7)	971	88.0 (86.3, 89.4)	101	92.0 (86.5, 95.4)	.0763
Received evaluation for physical therapy	104	8.6 (7.2, 10.1)	67	7.2 (5.8, 8.9)	37	17.4 (13.1, 22.7)	.0001	72	5.9 (5.0, 7.1)	61	5.5 (4.6, 6.6)	11	10.1 (6.3, 15.6)	.0594
Received assistance from nutritionist	526	44.9 (42.1, 47.7)	420	44.0 (41.0, 47.0)	106	50.8 (44.4, 57.2)	.0546	435	35.5 (33.3, 37.8)	395	35.5 (33.2, 37.9)	40	35.9 (29.6, 42.8)	.8967

†Unweighted sample size.

Note: Totals may not add up to the indicated overall unweighted sample size due to missing values and/or data that are not shown.

◊Weighted percentage.

‡P values are based on the Wald chi-square test of difference of distributions: Zika-exposed moms vs. non-Zika-exposed moms in each year.

*"Any special need" was determined by a maternal report indicating that the infant in question had one or more of the following health conditions possibly requiring further clinical care and management: hearing problems, vision problems, poor weight gain, feeding difficulties, smaller-than-normal head size, muscle weakness, deformities of the feet, or convulsions.

¶Relative standard error RSE > 50%; data not shown – estimates not reliable.

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Table 3.

Locations where infants usually received health care services and whether infants had a personal doctor, reported by women with a live birth in Puerto Rico in 2016 and 2017, by Zika infection status.

	2016 births							2017 births						
	Maternal Zika Infection Status						Chi-square P value‡	Maternal Zika Infection Status						Chi-square P value‡
	Total (n = 1,141)*		No (n = 941)		Yes (n = 200)			Total (n=l,196)		No (n = 1,089)		Yes (n = 107)		
Location	n†	% (95% CI)	n†	% (95% CI)	n†	% (95% CI)		n†	% (95% CI)	n†	% (95% CI)	n†	% (95% CI)	
Private doctor's office	607	53.6 (50.9, 56.4)	520	55.2 (52.2, 58.1)	87	43.4 (36.7, 50.3)	.0004	651	54.7 (52.6, 56.7)	595	54.8 (52.6, 57.0)	56	52.8 (45.7, 59.8)	.7644
Health department clinic	401	35.2 (32.5, 38.0)	322	34.3 (31.5, 37.3)	79	40.7 (33.9, 47.8)		400	33.0 (31.0, 35.1)	362	32.9 (30.8, 35.0)	38	34.5 (28.4,41.2)	
Regional pediatric center	47	3.8 (3.0, 4.9)	28	3.0 (2.1, 4.1)	19	9.6 (6.6, 13.9)		52	4.5 (3.6, 5.5)	46	4.4 (3.5, 5.5)	6	5.8 (3.2, 10.4)¥	
Other location	86	7.4 (6.1, 8.8)	71	7.5 (6.2, 9.1)	15	6.3 (4.0, 10.0)		93	7.8 (6.7, 9.1)	86	7.9 (6.7, 9.3)	7	6.8 (3.8, 11.9)	
Personal Doctor Baby has personal doctor	959	82.9 (80.9, 84.8)	792	83.6 (81.4, 85.7)	167	78.5 (72.4, 83.5)	.0956	1,131	92.8 (91.6, 93.8)	1,029	92.8 (91.6, 93.9)	102	92.7 (88.2, 95.6)	.9707

*n differs from other tables due to missing values for this indicator.

†Unweighted sample size.

‡P values are based on the Wald chi-square test of difference of distributions: Zika-exposed moms vs. non-Zika-exposed moms in each year.

¥Relative standard error RSE for the estimate is from 30–50%; estimates should be interpreted with caution.