RESEARCH ARTICLE

RUBELLA IMMUNITY RATES IN WOMEN OF CHILDBEARING AGE IN AN URBAN TEACHING HOSPITAL

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ABSTRACT:

Rubella is a highly contagious viral infection that can cause devastating effects on a growing fetus. Although rubella can be prevented with the measles, mumps and rubella (MMR) vaccine, some individuals have a weak immune response and do not sustain an adequate antibody titer to protect against the disease. MMR antibody titers are not routinely assessed in the general population, although healthcare professionals, military workers and pregnant women are commonly screened. This study aimed to investigate rubella immunity rates in primiparous women. The authors believed that the nonimmunity rate would be substantial enough to justify potential rubella immunity screening in all women of childbearing age at annual gynecologic exams prior to pregnancy. Findings recommend obtaining a rubella titer, as well as a measles titer, when women present for their first gynecological visit.

INTRODUCTION

Rubella is a highly contagious viral infection that causes fever, lymphadenopathy and a maculopapular rash.[1,2] While typically a self-limiting infection with no long-term sequelae, rubella can cause devastating effects on a growing fetus. Rubella infection in the first trimester of a nonimmune woman's pregnancy can cause congenital rubella syndrome, which includes multiple congenital anomalies, such as congenital heart defects, sensorineural deafness, cataracts, hemolytic anemia, meningoencephalitis and microphthalmia.[3] Rubella infection could also lead to first- or second-trimester fetal loss, preterm labor and delivery, or intrauterine growth restriction.[4] Rubella can be prevented with the measles, mumps and rubella (MMR) vaccine that is administered between 12 and 15 months of age and again between 4 and 6 years of age. The vaccine can also be given in adolescence and adulthood to those not immunized during childhood. MMR is a live attenuated vaccine and contraindicated in pregnancy.[1] In some individuals, the immune response to the MMR vaccine is weak and does not sustain an adequate antibody titer to protect against the disease.[5] MMR antibody titers are not routinely assessed in the general population, although healthcare professionals, military workers and pregnant women are commonly screened for the titer. Because the MMR vaccine is contraindicated in pregnancy, nonimmunized patients face their entire pregnancy with the risk of potential infection.

This study aimed to investigate rubella immunity rates in primiparous women. We believed that the nonimmunity rate would be substantial enough to justify potential rubella immunity screening in all women of childbearing age at annual gynecologic exams prior to pregnancy.

METHODS

After expedited approval from Henry Ford Health System's Institutional Review Board, this retrospective study used the electronic medical record system to identify all primiparous patients in our health system's department of women's health from July 2013 to July 2018.

Multiparous women were excluded, as they could have previously been immunized after a recent pregnancy and may have skewed the percentage of immune individuals.

Patients were categorized as rubella immune (rubella immunoglobulin G [IgG] antibody titers > 1.0 enzyme linked immunosorbent assay [ELISA] units) or rubella nonimmune (IgG titers ≤ 1.0 ELISA units). All data collected were in ELISA units, and ELISA assays were conducted in the facility. The rubella titers were drawn at the first obstetric intake visit. The intake appointment ranges in gestational age from patient to patient depending on when they sought prenatal care. Descriptive data collected included maternal age, pre-pregnancy body mass index (BMI), race/ethnicity and birth country. Although patients were not routinely asked about their country of birth, a patient's

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primary language was documented for interpreter services. For the purposes of this study, patients who self-identified their primary language as any other than English were considered to be born outside of the United States. Variables assessed included rubella immunity rates by race/ethnicity, non–English-speaking population, BMI and age. Age categories included teen pregnancy (14–19 years old), average reproductive age pregnancy (20–34 years old) and advanced maternal age pregnancy (≥ 35 years old). BMI included underweight (< 18.5 kg/m2), normal weight (18.5–24.9 kg/m2), overweight (25–29.9 kg/m2), obese (30–34.9 kg/m2), morbidly obese (35–40 kg/m2) and super obese (≥ 41 kg/m2). Race/ethnicity included Caucasian, African American, Hispanic, Asian/South Pacific, Native American, Middle Eastern and other.

The descriptive data were analyzed using SAS version 9.4 (SAS Institute, Cary, North Carolina) for statistical analysis. To then correlate data, a Spearman correlation test, chi-square test and Cochran-Armitage trend test were run, based on the type of data set analyzed.

TABLE 1:

Patient Demographics

		N (%)
Age (years)	Younger than 20	541 (19.3%)
	20–34	2,157 (76.8%)
	35 or older	111 (4.0%)
Body mass index (kg/m2)	Less than 18.5	116 (5.4%)
	18.5–24.9	909 (42.2%)
	25.0–29.9	543 (25.2%)
	30.0–34.9	269 (12.5%)
	35.0–39.9	154 (7.2%)
	40.0 or more	161 (7.5%)
Race	Caucasian	556 (20.9%)
	African American	1,247 (47.0%)
	Asian/South Pacific	150 (5.6%)
	Hispanic	35 (1.3%)
	Other	668 (25.2%)
Ethnicity	Hispanic/Latino	416 (15.6%)
	Non-Hispanic/ Latino	2,252 (84.4%)
Primary language	English	224 (8.1%)
	Arabic	95 (3.4%)
	Spanish	40 (1.4%)
	Bengali	95 (3.4%)
	Other	40 (1.4%)
Rubella immunity status	Not available	103 (3.7%)
	Nonimmune (titer < 1.0)	272 (9.7%)
	Equivocal (titer = 1.0)	56 (2.0%)
	Immune (titer > 1.0)	2,378 (84.7%)

RESULTS

Of the 2,809 primiparous women identified, 2,378 (84.7%) were rubella immune, 272 (9.7%) were rubella nonimmune, 56 (2.0%) were equivocal, and 103 (3.7%) did not have a rubella titer drawn during pregnancy. Patient demographics are provided in Table 1.

There was no correlation between immunization status and age. Immune patients had a lower BMI ($P < .001$), were more likely to be non-Hispanic/Latino ($P < .001$) and were more likely to have a non-English primary language ($P = .017$) compared to the equivocal and nonimmune patients. Immune and equivocal patients were more likely to be African American ($P = .042$), compared to the nonimmune patients (Table 2).

DISCUSSION

In our study's primiparous population, 11.7% of women (9.7% rubella nonimmune and 2.0% equivocal) needed a rubella immunization after pregnancy and were susceptible during pregnancy to contracting rubella. Nonimmune women may not pass a robust immunity to the fetus, leaving the infant with no maternal antibodies for protection in the first 6 months of life.[6] In a 16-year review on MMR immunity rates among different populations, young adults between 15 and 30 years old were identified as a group that would potentially benefit from a booster vaccination. Antibody titers were lower in this age group than the other age groups studied.[6] For these reasons, many studies have recommended that young adults should be revaccinated.[7–9] We stratified our subjects by age but found no significant differences based on age groups of teen pregnancy, average reproductive age and advanced maternal age.

The immune patients in our study had significantly lower BMIs. Obese individuals are at risk for infections and have immune system dysfunction, which may hinder their response to immunizations.[10] Obesity and immunization response has been well-studied in regard to hepatitis B vaccinations, where an inverse correlation was found between a BMI > 30 kg/m2 and hepatitis B antibody titers.[11] Other studies have shown that up to 45% of obese adults have no detectable anti-hepatitis B titer and 60% have inadequate antibody titers, reducing protection compared to those of normal weight.[10] Given our findings, patients who are obese could benefit from a titer test as part of an annual examination to provide booster vaccinations if needed.

Our study also suggested that immune patients are more likely to be non-Hispanic/Latino and more likely to have a non-English primary language compared to the equivocal and nonimmune patients. In this study, we assumed that individuals who do not speak English as their first language and who required interpreter services were not born in the United States. We hypothesized that these individuals would be more likely to be rubella immune due to immigration regulations. Patients who have recently immigrated typically have paperwork with updated vaccinations, which are administered upon arrival to the United States. Hispanic individuals in the United States have been found more likely to be affected by rubella and more likely to contract congenital rubella, possibly because Mexico did not start an MMR vaccination program until

TABLE 2:

Association of Patient Characteristics with Immunity

		Nonimmune (Titer < 1.0)	Equivocal (Titer = 1.0)	Immune	*P*-value
Age (years)	Younger than 20	38 (14.0%)	14 (25.0%)	467 (19.6%)	.104 (S)
	20–34	221 (81.3%)	41 (73.2%)	1815 (76.3%)	
	35 or Older	13 (4.8%)	1 (1.8%)	96 (4.0%)	
Body mass index (kg/m2)	Less than 18.5	8 (3.8%)	2 (5.4%)	103 (5.6%)	<.001 (S)*
	18.5–24.9	69 (32.7%)	13 (35.1%)	806 (43.6%)	
	25.0–29.9	52 (24.6%)	5 (13.5%)	463 (25.1%)	
	30.0–34.9	39 (18.5%)	6 (16.2%)	218 (11.8%)	
	35.0–39.9	23 (10.9%)	5 (13.5%)	125 (6.8%)	
	40.0 or more	20 (9.5%)	6 (16.2%)	132 (7.1%)	
Race	Caucasian	64 (24.9%)	12 (21.4%)	463 (20.6%)	.042 (C)*
	African American	96 (37.4%)	28 (50.0%)	1066 (47.5%)	
	Asian/Hispanic/ Other	97 (37.7%)	16 (28.6%)	717 (31.9%)	
Ethnicity	Hispanic/Latino	60 (22.7%)	14 (25.9%)	334 (14.8%)	<.001 (CA)*
	Non-Hispanic/ Latino	204 (77.3%)	40 (74.1%)	1923 (85.2%)	
Primary language	English	219 (81.1%)	50 (89.3%)	1778 (75.7%)	.017 (CA)*
	Non-English	51 (18.9%)	6 (10.7%)	571 (24.3%)	

1998.[12] Our study also showed that immune and equivocal patients were significantly more likely to be African American compared to the nonimmune patients. A Mayo Clinic study found that African Americans had higher rubella antibody titers compared to other races due to genetic differences in immune systems.[13]

A steady rise of measles outbreaks in the United States emphasizes the importance of MMR vaccination, especially for those in a high-risk medical community. In January–May 2019, there were 880 cases of measles recorded in the United States, more than double the number from 2018.[1] Measles may lead to serious complications, including pregnancy loss, preterm birth and low birth weight.[14] Pregnant women with measles have an increased risk of hospitalization and pneumonia compared to the general population.[14] Rubella immunity does not influence measles immunity, though it is contained in the same immunization. Furthermore, rubella antibody titers are more likely to be in the immune range than measles titers.[15] Thus, a small population of women who are rubella immune may not be measles immune, and they could benefit from an additional dose of MMR, highlighting the need for thorough immune status surveillance. It is important to evaluate rubella immunity to maintain herd immunity; however, measles serology should also be considered in women of reproductive age given the number of outbreaks.

COMMENT

There is a lack of data in the literature describing rubella immunity rates in pregnancy within the United States. There have been smaller studies in rural areas of the country; however, the sample sizes of these populations are relatively small. By having a high-powered study reflecting the population of a diverse urban hospital, we feel that we can get a better sense of the population's rubella immunity status in pregnancy. The goal is to justify earlier screening or booster immunization to women of childbearing age so they do not go through a pregnancy nonimmune, leaving them exposed to potential illness. Study limitations include that this is a single-center study, which means we do not have a good representation of the general population. The retrospective nature of the study limited us from accurately identifying U.S.-born individuals.

CONCLUSION

Based on our study findings and previous research, we suggest the feasible option of obtaining a rubella titer, as well a measles titer, when women present for their first gynecological visit, which would ideally be at the age of 18. This allows for ample time to immunize, if needed, prior to conception. Individuals at high risk for rubella nonimmunity, such as those who are obese or Hispanic, should have a titer drawn or be offered a booster immunization in adolescence.

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