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Factors Associated with Influenza Vaccine Uptake among Pregnant Women: Analysis of the 2015 Georgia Vital Events Information System Birth Worksheet

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ABSTRACT

FACTORS ASSOCIATED WITH INFLUENZA VACCINE UPTAKE AMONG PREGNANT WOMEN: ANALYSIS OF THE 2015 GEORGIA VITAL EVENTS INFORMATION SYSTEM BIRTH WORKSHEET

by

ELIZABETH M. GRABOWSKI

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INTRODUCTION: Influenza is a public health concern each influenza season in the United States (US). Annually, about 50,000 people die due to influenza complications in the US. Pregnant women and children under the age of five are two of the most at-risk groups for influenza-related morbidity and mortality. Since 2004, the Centers for Disease Control (CDC), the Advisory Committee on Immunization Practice (ACIP), and the American College of Obstetricians and Gynecologists (ACOG) have recommended that women who will be pregnant during the influenza season get vaccinated. Vaccination of mothers also protects infants for up to the first six months of life through the active transfer of maternal antibodies in the womb. Vaccination during pregnancy is safe and is the most effective way for mothers to protect themselves and their infants from the influenza virus.

PURPOSE: Vaccination rates among pregnant women in Georgia are low, despite the CDC, ACIP, and ACOG recommendation to be vaccinated for influenza during pregnancy. In 2013, only 23.7% of women in Georgia received an influenza vaccine before or during pregnancy, a number well below the national average of 55.3% for the same year. The purpose of this study is to determine which factors are positively associated with influenza vaccine uptake during

pregnancy in Georgia through an analysis of the 2015 Georgia Vital Events Information System (VEIS) Birth Worksheet. The author believes that by identifying which factors show an increase in vaccine uptake, clinicians will be able to beneficially direct vaccine promotion efforts among pregnant women in Georgia.

METHODS: Secondary data from the 2015 VEIS Birth Worksheet was obtained from the Georgia Department of Public Health. 130,133 women between the ages of 18 – 49 completed a Birth Worksheet in 2015 and were included in the study. Variables used for regression analysis, descriptive analysis, and prevalence of vaccine uptake include: age, race, education level, perinatal region of residence, and receipt of prenatal care. An extensive review of existing literature was also conducted.

RESULTS: The prevalence of influenza vaccine uptake among pregnant women varied across the variables. 13.39% of women who completed a Birth Worksheet in 2015 reported that they received an influenza vaccine during pregnancy. The prevalence of vaccine uptake was highest among white women (65.26%), women between the ages of 25 – 34 (60.16%), women with a college degree (51.03%), and women living in the Atlanta perinatal region (44.52%). Surprisingly, of all the Atlanta region respondents, only 10.32% received an influenza vaccine despite having the largest population of all the regions in Georgia. Almost all women who received an influenza vaccine during pregnancy also received prenatal care (98.48%). Of the 115,443 women who received prenatal care, 14.87% received an influenza vaccine.

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APPROVAL PAGE

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Author's Statement Page

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Introduction

Background

The influenza virus is a public health concern each influenza season in the United States (US). Annually, about 50,000 people die because of influenza complications in the US [1]. The influenza season typically lasts from October to late spring with different strains circulating among the population each season [1]. Influenza is defined as a contagious respiratory illness, with the illness ranging from mild to severe [2]. Complications due to influenza can cause pregnant women, and infants, to be hospitalized or to visit hospital emergency rooms (ER) [3].

Pregnant women and children under the age of five are two of the most at-risk groups for influenza-related morbidity and mortality [4]. The best way for people, especially pregnant women, to protect themselves from influenza is to receive a seasonal influenza vaccination before the start of the influenza season [1].

Since 2004, the Centers for Disease Control and Prevention (CDC), the Advisory Committee on Immunization Practice (ACIP), and the American College of Obstetricians and Gynecologists (ACOG) have recommended that women who are pregnant during the influenza season get vaccinated [5]. This is because pregnant women are vulnerable to influenza and have an increased risk of being hospitalized with severe illness caused by the virus [6]. Infants are another vulnerable group that is at-risk for contracting influenza, but infants do not receive an influenza vaccine until six months of age. Mothers who receive the vaccine during pregnancy will help protect their babies from the influenza virus for the first six months of life [7].

Purpose of Study

Vaccination rates among pregnant women are low in Georgia despite the recommendation to receive the vaccine during pregnancy. In 2013, only 23.7% of women in Georgia received an influenza vaccine before or during pregnancy, a number well below the national average of 55.3% for the same year [8]. It is important to understand the factors that influence influenza vaccine uptake among pregnant women due to their vulnerability for contracting the virus and higher likelihood of being hospitalized with influenza complications. The aim of this study is to determine which factors are associated with receipt of the influenza vaccine, as recommended, during pregnancy.

Research Questions

- What factors are associated with influenza vaccine uptake among pregnant women in Georgia?
- Are women who receive prenatal care likely to receive the influenza vaccine during pregnancy?
- Of Georgia's six perinatal regions, which have the highest and lowest rates of influenza vaccination among pregnant women?

Review of the Literature

Influenza

The most severe outcomes of influenza are hospitalization and death [2]. Despite this information, only about 50% of pregnant women receive an influenza vaccine in the US.

Pregnancy Outcomes. During the 2009-2010 influenza season, 29.8% of pregnant women in Georgia, who were told by a healthcare worker that they had influenza, were hospitalized [9]. This rate was unnecessarily high because the percentage of pregnant women receiving the influenza vaccine during the 2009-2010 season was only 32.1% [10]. Due to changes in the immune system, lungs, and heart throughout pregnancy, women who are pregnant are more susceptible to severe illness caused by influenza compared to women who are not pregnant [7].

Most people who become ill due to the influenza virus recover without any harmful outcomes. Unfortunately, influenza-related sequela for at-risk groups such as pregnant women, the elderly, young children, and those with chronic diseases include serious illness and death [11]. Women who have comorbidities such as asthma, diabetes, or multifetal gestation (twins) are at a higher risk of serious illness from influenza [5]. While pregnant women generally account for only 1% of the population at any given time, in 2009 they accounted for 5% of U.S. influenza related deaths [12].

Contracting influenza during pregnancy can have serious effects on a fetus. The CDC [7] reports that premature labor and delivery are some of the most serious fetal problems associated with influenza-related illness during pregnancy. An infant born premature (before 37 weeks gestation) can face a lifetime of health complications including increased rates of mortality, breathing issues, learning disabilities, and hearing and vision problems [13]. Fetal congenital

abnormalities [14], and a predisposition to otitis media and bacterial pneumonia are also of concern for infants born to mothers who had influenza while pregnant [15].

Influenza Vaccine

To prevent the aforementioned maladies and increased rates of influenza-related mortality, pregnant women, of any trimester, should receive the influenza vaccine as it becomes available during the influenza season [16]. The influenza vaccine is modified each year after experts assess data to determine which strains of the influenza virus will most likely be circulating among the population in the upcoming influenza season. [17]. Vaccines are then distributed each fall to pharmacies and healthcare facilities before the start of the influenza season. The vaccine is safe for those who are pregnant or breastfeeding [7]. Anyone can obtain an influenza vaccine through a healthcare provider, or through a pharmacy or local health department without a prescription. If obtained outside of the obstetrical practice, it is important for a pregnant woman to inform her obstetrical clinician of vaccine receipt so it can be documented in her prenatal record.

Recommendations. The trivalent inactivated influenza vaccine is recommended for women during pregnancy [3]. The ACIP has recommended vaccination among pregnant women since 1990 [14]. Pregnant women should not receive the Live, Attenuated Influenza Vaccine (LAIV) [11]. While the inactivated vaccine contains killed virus, the LAIV contains an attenuated virus which still has the capability to replicate and may make those who receive it feel ill with mild influenza symptoms [11]. The inactivated vaccine is safe for both mother and her unborn baby, with the baby being protected from birth up to six months after birth [3] through the transfer of maternal antibodies [11]. Maternal antibodies can also be transferred to infants through breastmilk [18]. The vaccine has been proven to provide a two-for-one benefit in

protecting mothers and infants from influenza [15]. In a retrospective cohort study of 10,225 mothers who received the influenza vaccine while pregnant, newborns did not have any increase of major malformations [5]. The study provides evidence that fetuses are not placed at harm if mothers receive the vaccine. Studies that prove vaccine safety are imperative for vaccine uptake among women who are pregnant during the influenza season.

Contraindications. The ACIP lists a few contraindications for the influenza vaccine in their 2016-2017 seasonal influenza recommendation report. Those who have had any previous, severe allergic reaction to an influenza vaccine should not receive the vaccine [11]. Vaccine package inserts state that those who have had precious allergic reactions to egg should not receive the vaccine, but the ACIP states that people with egg allergy can receive the vaccine provided they are monitored by a healthcare professional following vaccine administration [11]. Other contraindications are having an allergy to any component of the vaccine, people with moderate or severe illness at the time the vaccine is sought, and those who are not at high-risk for severe flu complications and who are known to have developed Guillain-Barre syndrome (GBS) within 6 weeks after receiving a previous influenza vaccination [19]. If a person does not meet any of the contraindication criteria, then it is safe and recommended for him/her to receive the influenza vaccine.

Maternal Outcomes. Seasonal influenza-related hospitalization in healthy pregnant women occurs at a rate of 1 to 2 per 1,000; a risk that is 18-fold greater than that for healthy women who are not pregnant. [20]. Vaccinated mothers were found to be 36% less likely to become ill with influenza symptoms compared to those who did not receive the influenza vaccine [15]. The vaccine can reduce the risk of severe flu among pregnant women by about 50% [21].

Infant Outcomes. Besides protecting women from contracting influenza during pregnancy, maternal vaccination has benefits for the growing fetus and infant. Vaccination during pregnancy has a strong protective factor for both fetuses and infants. Stillbirth, neonatal death, and premature delivery were significantly decreased among mothers who were vaccinated for influenza in Sheffield et al.'s study of 10,225 women [5]. Among women who were vaccinated during the first trimester, their infants faced an overall decrease in stillbirth rate and there was no association between vaccination and an increase in major malformation rates [5]. A retrospective study of 58,000 births was conducted in Australia over the 2012 – 2013 influenza season. The researchers found that stillbirth was 51% less likely among those vaccinated compared to those who were unvaccinated [22]. Moreover, in a review of 3,000 births following influenza immunizations in 2009, Kaiser Permanente found that for every twenty-four women who were vaccinated while pregnant, one preterm birth was prevented [20].

The vaccine is also effective at reducing the rate of infants being hospitalized with influenza complications. Immunized mothers give birth to infants who have an eighty-one percent risk reduction for influenza-related hospitalizations during their first six months of life [22]. The health benefits of receiving an influenza vaccine during pregnancy are evident in the numerous studies that have been conducted on vaccine safety and efficacy for both mother and child.

The vaccine given to the mother during pregnancy also protects infants (who do not get vaccinated until they are six months of age) through in utero transmission of maternal influenza antibodies [3]. Vaccination of infants less than six months is not recommended because it is ineffective.. An infant's immune system will not respond to the influenza vaccine to develop protective antibodies [23]. Thus, the first influenza vaccine an infant receives is at six months —

at which time the infant receives two vaccines several weeks apart [24]. A randomized trial conducted in Bangladesh, India, found that vaccinating women during their third trimester of pregnancy reduced the rate of confirmed influenza in their infants [15]. Effectiveness at preventing influenza among infants whose mothers did receive the vaccine was 63% compared to infants whose mothers were not vaccinated [15]. A retrospective cohort study of 7,126 mother-infant pairs conducted in Australia found that the influenza vaccine is safe for infants based on an analysis of birthweights and gestation at birth. McHugh et al. did not discover any statistically or clinically significant difference in infant birthweight or gestational age at birth among infants whose mothers received the influenza vaccine while pregnant [25]. Low birthweight or preterm infants are at-risk of health complications that could last a lifetime. Ideally, an infant will weight 2,500 grams or more at birth; anything less than 2,500 grams is defined as low-birthweight [26]. McHugh et al.'s findings suggest that the influenza vaccine can be administered during any trimester without adverse birth outcomes.

Factors that Influence Vaccine Uptake. In 2004, the ACIP removed its first trimester restriction and now recommends that women who are pregnant during the influenza season be vaccinated during any trimester [14]. This change had a positive impact on influenza vaccine uptake during the first trimester among pregnant women; the proportion of women who received the vaccine in the first trimester more than doubled from the 2003-2004 to 2004-2005 influenza seasons [14]. Pregnancy lasts an average of forty weeks; these weeks are split into three trimesters. The first trimester is from weeks zero-thirteen, the second trimester is from weeks fourteen to twenty-seven, and the third trimester is from weeks twenty-eight to forty [27]. Previously, there was concern that the vaccine might harm fetuses during the first trimester so the ACIP did not recommend women to be vaccinated during that trimester. After concerns were

unsubstantiated, the ACIP revised its recommendations to include influenza vaccination during the first trimester.

In Sheffield et al.'s study, it was found that women who received the influenza vaccine were of higher income and age than women who declined the vaccine [5]. Pregnancy Risk Assessment Monitoring System (PRAMS) data for the 2009-2010 season also reveals that as maternal age increases, so does receipt of the influenza vaccine [10]. Another predictor that influences vaccine uptake is co-morbidities; McHugh et al. found that mothers were 13% more likely to be vaccinated if they had any risk-factor or co-morbidity [25]. The CDC reports that women are five times more likely to report receipt of the influenza vaccine during pregnancy if their healthcare provider offers it to them, compared to women who are not offered vaccination from their provider [28]. Women are more likely to believe the vaccine is safe, effective, and protective if it is offered by their doctor [22]. Influenza vaccine offers from healthcare providers have a significant influence on influenza vaccine uptake.

Women who have previously received the influenza vaccine are more likely to be vaccinated during pregnancy [14]. In addition to these factors, women who will have a longer overlap with the influenza season are also more likely to be vaccinated [14]. Women with a longer pregnancy overlap acknowledge their risk of contracting the influenza virus and are vaccinated at a higher rate than those with shorter overlaps. Meharry et al. discovered that women who knew of the influenza vaccine's two-for-one benefit to protect themselves and their infants from the influenza virus were more likely to be vaccinated [3].

Barriers. A major barrier to influenza vaccination is the concern about the safety of the vaccine that is held by both pregnant women and some healthcare employees [5]. These concerns are unfounded because no study has yet seen an association between adverse outcomes and

influenza vaccination in pregnancy. Some women have a "fear if I do and fear if I don't" mentality about the influenza vaccine [3]. They understand they are more susceptible to the influenza virus while pregnant, but are worried that the vaccine could cause harm to themselves or their unborn baby [3]. Evidence that shows the influenza vaccine is safe can help promote vaccine uptake among pregnant women, reducing morbidity and mortality rates among pregnant women and their infants who are too young to be vaccinated [25].

An analysis of eight years of Georgia PRAMS data found that the most commonly cited reason for not receiving an influenza vaccine was "I don't normally get a flu vaccine" [29]. The two other most common reasons cited were "Worried about side effects of vaccination for me" and "Worried about harming the baby", with Hispanic women being the highest proportion of women citing the last reason [29]. Those who state they do not need the vaccine sometimes also fear the vaccine. They feel that they are healthy and not at-risk for influenza complications so they fear the potential the vaccine has to change their health status [3]. Women with this fear do not wish to change the status quo, so they do not receive the influenza vaccine during pregnancy.

Healthcare providers are also barriers to vaccination. If providers do not mention or recommend to pregnant women that they should receive the influenza vaccine, women are less likely to be vaccinated. Providers have significant influence on women's decisions while they are pregnant [3]. In 2011, 27.1% of women who responded to the Georgia PRAMS survey said that they did not receive the influenza vaccine because their provider did not mention it [29]. This rate was even higher in 2005 with 54.2% of PRAMS participants citing "Doctor did not mention influenza vaccination" [29].

Cost-effectiveness. Not only does the influenza vaccine decrease the risk of adverse maternal and infant outcomes, vaccinating women during pregnancy is cost-effective. Xu et al.

found that pregnancy related outpatient visits and hospitalizations of mothers and infants decrease when women receive the vaccine during pregnancy [30]. Influenza vaccination of all pregnant women can save an average of $107,742,336 in direct maternal and infant medical costs a year, in the US [30]. Vaccination of pregnant women is estimated to save 123 quality-adjusted life years (QALYS) in a mild influenza season and up to 610 QALYS in a moderately severe season in the US [30] . One QALY is equivalent to one year of perfect health. When a person is in perfect health, the amount spent on healthcare is less than if they were ill.

Methods

Participants and Procedures

After excluding those women who gave birth in 2014 because the available data was only for the last six months of the year, the sample size of all women who gave birth and completed a Georgia Birth Worksheet in 2015 was 130,133 women. All participants were female and their ages ranged from 18 to 49 years. Those younger than 18 and older than 49 were excluded from the data set. Of the participants, most were white (52.95%), the majority resided in the Atlanta perinatal region (57.76%), and 55.12% were in the 25 to 34 years old age range. The mean age of participants was 28.26 years (see Table 7). Additional demographic characteristics are located in Table 1. A map of Georgia's counties separated into the six perinatal regions can be found in Figure 1.

This study used secondary, quantitative data from the Georgia Vital Events Information System (VEIS) Birth Worksheet for the entire year of 2015. The VEIS Birth Worksheet is a requirement by the Georgia Vital Records Office following the birth of a child and is needed to complete legal birth certificates. The four-page worksheet asks questions about the infant's and mother's health, along with demographic questions [31]. After completing the worksheet,

mothers submit it to the Vital Records Office for processing. Beginning July 1st, 2014, the question about influenza vaccination during pregnancy was added to the Birth Worksheet. Figure 2 shows an extract of the Georgia VEIS Birth Worksheet's question 51.

Measures

Vaccination. The primary vaccination variables were question 51 of the Birth Worksheet: influenza vaccination during pregnancy (yes or no) and trimester of vaccination (first, second, or third). The variable for influenza vaccination during pregnancy was coded dichotomously for analysis; if a respondent answered yes, it was coded to 1 and if a respondent answered no, it was coded to 2. The variable for trimester of influenza vaccination was coded 1- first trimester, 2- second trimester, and 3- third trimester.

Perinatal Region of Residence. The variable for residence was question 21, county of residence. All 159 Georgia counties were assigned to their respective Georgia Perinatal Region using the map from the Georgia Department of Public Health (Figure 1) as a guide. Counties in Alabama, Florida, South Carolina, North Carolina, and Tennessee that border Georgia were assigned to their respective Perinatal Region because residents from bordering counties commonly seek prenatal care and delivery services in Georgia. Counties from states outside of Georgia that do not border the state were assigned as "out-of-state" for analysis purposes.

Prenatal Care. The primary variable for prenatal care was question 53 a, Did mother receive prenatal care? Responses were yes, no, or unknown. These responses were coded as 1- yes, 2- no, and 3- unknown.

Demographics. Demographic variables used in this study were mother's race (Asian, Black/African American, Hawaiian/Pacific Islander, White, American Indian/Alaskan Native, other, and unknown), mother's age at time of infant's birth (18 - 20, 21 - 24, 25 - 34, 35 - 49

years), and mother's education level (less than high school degree, high school degree/GED, college degree, and unknown).

For the purposes of this study, the independent variables of interest are mother's age at time of birth, mother's race, mother's education level, did the mother receive prenatal care during pregnancy, and mother's perinatal region of residence. The dependent variables of interest are influenza vaccination during pregnancy and trimester of vaccination.

Statistical Analysis

All data analyses were performed using Microsoft Excel 2016 Data Analysis ToolPak. Regression analysis was performed to evaluate the association of age, education level, perinatal region of residence, race, and prenatal care on vaccination receipt. The descriptive statistics procedure was used to conduct univariate analysis to determine mother's mean age at time of infant's birth. Pearson correlation coefficient was conducted to determine the strength of the relationship between mother's age and receipt of influenza vaccine.

Results

The prevalence of influenza vaccination uptake among pregnant women varied across the demographic variables found in Table 2. 17,428 women reported that they received an influenza vaccine during their pregnancy in 2015 (13.39% of all Birth Worksheet respondents). Of those 17,428 women, 65.26% were white, 60.16% were 25 - 34 years of age, 44.52% resided in the Atlanta perinatal region, and 51.03% had a college degree. Almost all women who received an influenza vaccine also received prenatal care (98.48%).

Of the total sample population, 88.71% received prenatal care during pregnancy (Table 3). 14.87% of women who received prenatal care also received an influenza vaccine. Vaccine uptake among women who received prenatal care varied across trimesters (Table 4). 27.78% of

women who received prenatal care received the vaccine during the first trimester, 34.44% received the vaccine during the second trimester, and 35.68%, received the vaccine during the third and final trimester of pregnancy.

Influenza vaccination uptake by perinatal region of residence was examined next (Table 5). Of the six perinatal regions in Georgia, the Atlanta region had the highest percentage of women (44.52%) receiving influenza vaccines during pregnancy, and the Macon region had the lowest percentage of women receiving the vaccine (7.91%). .25% of women who completed a birth worksheet in 2015 *and* also received an influenza vaccine did not reside in a Georgia county so they were grouped together as "out-of-state". Women who received an influenza vaccine, but did not list a county of residence totaled .03% of all women vaccinated.

Next, the researcher examined the correlation that mother's age at time of infant's birth has on influenza vaccine uptake. Table 6 illustrates the positive trendline between increase in age and vaccine uptake. Women in the 25 – 34 years old age group had the highest rates of vaccination among all age groups. The largest increase in vaccination rates occurred between the 21 – 24 age group and the 25 – 34 age group.

The logistic regression model in Table 8 predicts influenza vaccine uptake among pregnant women by age, education level, race, perinatal region of residence, and receipt of prenatal care. Mother's age at time of infant's birth (OR = 0.13, 95% CI: 0.12, 0.15) and race (OR = 0.15, 95% CI: 0.10, 0.19) were associated with vaccine uptake. Pregnant women are 13% more likely to be vaccinated depending on their age. Table 6 also shows that age is positively associated with vaccine uptake. Race is also associated with vaccine uptake, with pregnant women being 15% more likely to receive the vaccine depending on race. Education level,

perinatal region of residence, and receipt of prenatal care was not significantly associated with an increase in influenza vaccine uptake among pregnant women.

Discussion

This analysis of the 2015 Georgia VEIS Birth Worksheet reports on some of the leading factors that are associated with influenza vaccine uptake among women during pregnancy. There is no data available for comparison, yet, as the question about influenza vaccination during pregnancy was added to the Birth Worksheet on July 1st, 2014 (Figure 2). The results of this study reveal that Georgia falls short of the Healthy People 2020 goal of having 80% of pregnant women vaccinated against influenza [32]. Only 13.39 percent of women who completed a Birth Worksheet in 2015 responded that they were vaccinated during pregnancy. This means over 86% of pregnant women were unprotected from seasonal influenza, putting their and their infants' health at risk.

There is a higher likelihood that Georgian women will receive the vaccine if they are white or black. Of all respondents who identified as American Indian/Alaskan Native, 15.92% received the influenza vaccine while pregnant. This rate is second only to white women (16.51% of white respondents being vaccinated). American Indians receive free healthcare through the Indian Health Service and reduced-cost health insurance through the Affordable Care Act (ACA) [33], thus increasing the likelihood they will get a vaccine because the cost-barrier is not there. Age of the mother at the time of infant's birth is also associated with vaccine uptake. As age increases from 18 – 34 years, so does influenza vaccine uptake. There is a decrease in vaccination from the 25 – 34 age group to the 35 – 49 age group (60.16% to 16.16%). This may be due to women fearing the increased chance of complications during pregnancy as they get

older. Providers can use this information to target the 35 - 49 age group that is more at-risk for influenza complications due to their age and pregnancy status.

It was unexpected to the researcher that as mothers' level of education increased, so did receipt of influenza vaccine. As education increases, typically so does level of knowledge on health, general well-being, and preventative care [34]. Factors such as education, are associated with health outcomes. Education level and employment status are root causes that influence income and poverty which in turn influences health disparities in Georgia [35]. A large gap exists between those with high and low education levels in the US, and education contributes to increased health literacy, preventative care, and the ability to navigate healthcare [36]. The results imply that as Georgia women gain more education, they understand the importance of preventative healthcare and the risk influenza could have on themselves and their infant, during and after pregnancy. Women with higher levels of education may also have access to healthcare providers that offer preventative measures like influenza vaccines or explain the risks of not being vaccinated.

A large proportion of Georgia's population resides in the metro Atlanta area, or for the purposes of this study, the Atlanta perinatal region. This region encompasses 46 of Georgia's 159 counties, more than any other perinatal region. Of those respondents who reported the Atlanta region as their residence, only 10.32% were vaccinated during pregnancy. The vaccination rate even fell behind those who were vaccinated in the out-of-state group (11.14%). These results are concerning because 57.7% of study participants reported living in the Atlanta perinatal region. More research as to why the most populous perinatal region in Georgia has the lowest rate of vaccine uptake needs to be done. Hopefully, the findings of the present study can guide future research into the issue.

The rate of women receiving prenatal care in Georgia in 2015 was high at 88.71%. Unfortunately, of these women who had at least one prenatal care visit, just 14.87% of them received an influenza vaccine. These women were in the presence of healthcare professionals, but were either not offered the vaccine, they declined the vaccine, or perhaps did not learn of the importance of influenza vaccination during pregnancy. A concerning barrier to vaccination found in a study of Georgia PRAMS data was that "Doctor did not mention influenza vaccination" [29]. A major barrier discussed in a previous section of this paper is concern about the safety of the vaccine by both pregnant patients and healthcare employees [5]. Evidence exists on the safety of the influenza vaccine during pregnancy for both mother and baby. The vaccine even protects infants for up to the first six months of life [3]. Evidence needs to be more readily available to pregnant women and healthcare providers so that this barrier can be eliminated.

Limitations. There are a few limitations to consider when interpreting the results of this study. First, the data was subject to recall bias. Women who have recently given birth may not remember if and when they were vaccinated against influenza. There is also the small risk they may not recall if they received prenatal care. Second, there is the risk of self-report bias; women reporting they received a vaccine or prenatal care because they perceive that to be the socially acceptable answer even if they did not receive either the vaccine or prenatal care. Lastly, the study reported on women ages 18 – 49. Women younger than 18 and older than 49 were excluded, so the data is not representative of all women in the state of Georgia. The most commonly used childbearing age range was used for the purpose of this study.

Implications. This study emphasizes the need for public health promotion of influenza vaccination during pregnancy in the state of Georgia. Georgia's rates of vaccination are below the national average which is at about 50% [8]. Pregnant Georgians are at risk of costly

influenza-related complications that could result in hospital admission or even death. The cost-effectiveness of vaccinated pregnant women outweighs the disease-burden influenza has on this population and the rest of society [30].

Public health interventions should primarily target prenatal care providers because the clear majority of women received prenatal care in 2015. Providers can influence a woman's decision because their opinions are highly regarded during pregnancy. Women are generally more concerned about their health and how it affects their baby's health while they are pregnant. Most women who did receive an influenza vaccine while pregnant also received prenatal care. This implies that those women were offered the vaccine by a prenatal care provider or learned about the benefits of vaccination during a prenatal appointment.

Useful demographic information was found in this study. The researcher found that most of vaccine recipients were white, between 25 – 34 years of age, and had a college degree. Race, education level, and age are all influential in influenza vaccine uptake among pregnant women. Promotion efforts could target those groups that had the lowest rates of vaccination. Educating women about the two-for-one benefit that the vaccine provides will increase the likelihood they will receive the influenza vaccine [3].

Future research should further examine another potential factor that is associated with vaccine uptake: the socioeconomic status (SES) of pregnant women in Georgia. Perhaps cost is a barrier to vaccination for those with low SES. This could be a large barrier to overcome, but it could be targeted by programs and clinics that offer reduced healthcare to those in need. Also, comparing data across years could also help strengthen the associations between factors such as age, race, education level, prenatal care, and perinatal region of residence with influenza vaccine

uptake. This research would be on hold until the Georgia Department of Public Health is ready to release 2016 VEIS Birth Worksheet data.

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Table 1

Sample Characteristics

Variable	N	(%)
Race		
Asian	6,093	4.68
Black/African American	46,122	35.44
Hawaiian/Pacific Islander	202	0.15
White	68,900	52.95
American Indian/Alaskan Native	559	0.43
Other	4,851	3.73
Unknown	3,406	2.62
Age		
18-20	11,545	8.87
21-24	26,788	20.58
25-34	71,724	55.12
35-49	20,076	15.43
Education Level		
Less than High School Degree	17,393	13.37
High School Degree/GED	63,518	48.81
College Degree	46,827	35.98
Unknown	2,395	1.84
Perinatal Region of Residence		
Atlanta Region	75,168	57.77
Augusta Region	13,539	10.4
Columbus Region	10,791	8.29
Macon Region	7,389	5.69
Albany Region	9,280	7.13
Savannah Region	13,538	10.4
Out-of-state	395	0.3
Unknown	33	0.02
Total	130,133	

Table 2

Sample Characteristics by Vaccine Uptake

		(%)		Vaccine Uptake, N	
Variable	**Yes**	**%**	**No**	**%**	**Total**
Race					
Asian	634	10.40	5,459	89.59	6,093
Black/African American	4,624	10.02	41,498	89.97	46,122
Hawaiian/Pacific Islander	23	11.39	179	88.61	202
White	11,373	16.51	57,527	83.49	68,900
American Indian/Alaskan Native	89	15.92	470	84.08	559
Other	583	12.02	4,268	87.98	4,851
Unknown	102	2.99	3,304	97	3,406
Age					
18-20	1,188	10.29	10,357	89.71	11,545
21-24	2,847	10.63	23,941	89.37	26,788
25-34	10,477	14.61	61,247	85.39	71,724
35-49	2,816	14.03	17,160	85.47	20,076
Education Level					
Less than High School Degree	1,477	8.49	15,916	91.51	17,393
High School Degree/GED	6,970	10.97	56,548	89.03	63,518
College Degree	8,893	18.99	37,934	81	46,827
Unknown	88	3.67	2,307	96.32	2,395
Perinatal Region of Residence					
Atlanta Region	7,759	10.32	67,409	89.68	75,168
Augusta Region	2,323	17.16	11,216	82.84	13,539
Columbus Region	1,472	13.64	9,319	86.36	10,791
Macon Region	1,379	18.66	6,010	81.34	7,389
Albany Region	1,694	18.25	7,586	81.74	9,280
Savannah Region	2,752	20.33	10,786	79.67	13,538
Out-of-state	44	11.14	351	88.86	395
Unknown	5	15.15	28	84.85	33
Total	**17,428**	**13.39**			

Table 3

Prevalence of Vaccine Uptake by Receipt of Prenatal Care

Prenatal Care	N	%
Vaccine Yes	17,163	14.87
Vaccine No	98,280	85.13
Total	115,443	88.71

Table 4

Prevalence of Vaccination (by Trimester) among Women Who Received Prenatal Care *and* Influenza Vaccine

Prenatal Care	N	%
First Trimester	4,768	27.78
Second Trimester	5,910	34.44
Third Trimester	6,124	35.68
Other	361	2.1
Total	17,163	13.18
*****Other includes responses women gave other than 1st, 2nd, or 3rd trimesters		

Table 5

Prevalence of Influenza Vaccine Uptake by Perinatal Region of Residence

Influenza Vaccine Uptake	N	%
Atlanta Region	7,759	**44.52**
Augusta Region	2,323	13.33
Columbus Region	1,472	8.47
Macon Region	1,379	**7.91**
Albany Region	1,694	9.72
Savannah Region	2,752	15.97
Out-of-State	44	.25
Unknown	5	.03
Total	17,428	13.39

***** Highest and lowest rates are bolded

Table 6

Pearson's r Correlation Coefficient

	age	*vaccine YES*
age	1	
vaccine YES	0.387487	1

Scatter plot with data trendline illustrating a positive correlation between increase in age and influenza vaccine uptake

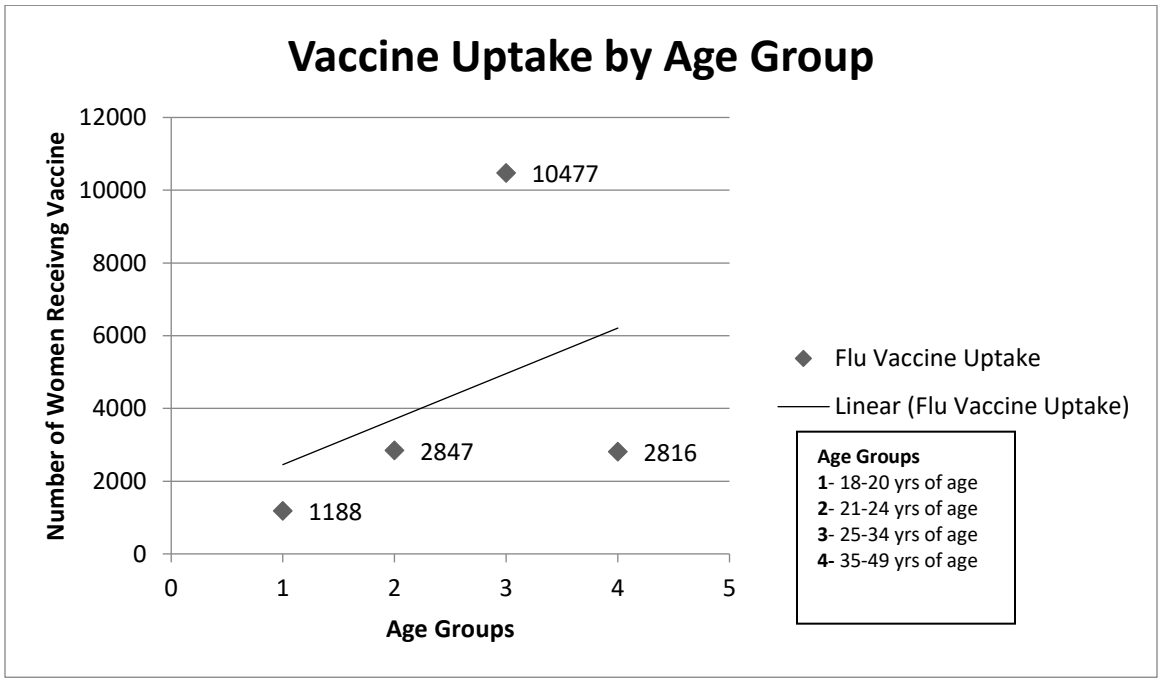


Table 7

Univariate analysis of Mother's Age at time of Infant's Birth

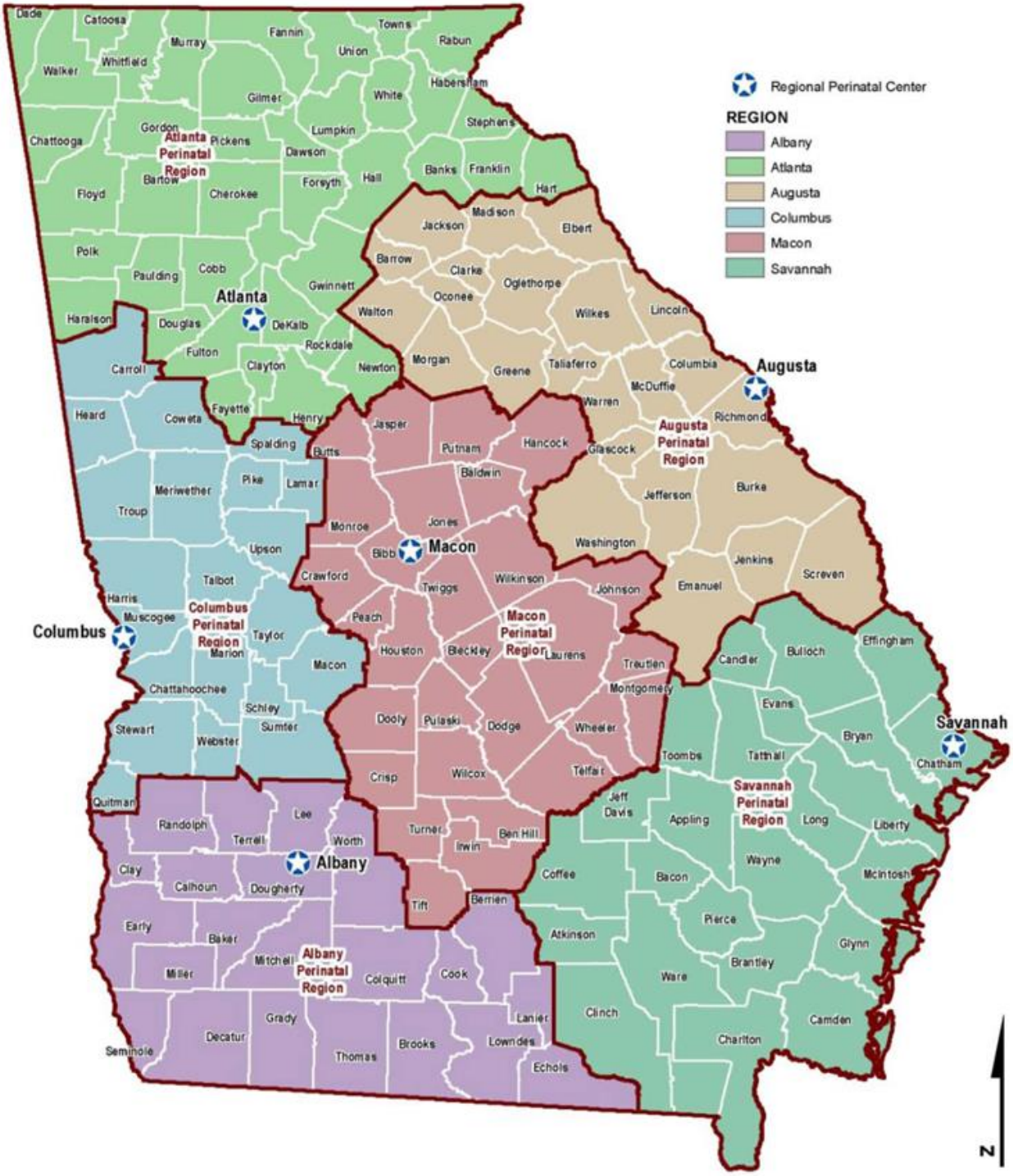
Mothers Age at time of birth	
Mean	28.26833317
Standard Error	0.015973881
Median	28
Mode	28
Standard Deviation	5.762409996
Sample Variance	33.20536896
Kurtosis	-0.52969523
Skewness	0.298663634
Range	31
Minimum	18
Maximum	49
Sum	3678643
Count	130133

Table 8

Logistic Regression Model for Influenza Vaccine Uptake

		95% CI	
Variable	**OR Estimate**	**Lower**	**Upper**
Mother's Age	0.13	0.12	0.15
Education Level	0.13	-0.06	0.33
Race	0.15	0.1	0.19
Perinatal Region of Residence	0.09	0.07	0.11
Receipt of Prenatal Care	0.07	0.06	0.07

Figure 1



Source: Georgia Department of Public Health. (2017, June 21). Regional Perinatal Centers. Retrieved June 25, 2017, from https://dph.georgia.gov/RPC

Figure 2

51. Vaccinations during pregnancy (Note trimester) □TDAP Trimester _____
□ Flu Trimester _____ □ Other Trimester _____ □ None

Source: State of Georgia Birth Worksheet. (2014). Retrieved May 19, 2017, from http://www.gamidwife.com/pdf/BIRTH_WORKSHEET-2014.pdf