Affordable Care Act and Access to Care: An Examination of Over 3 Million North Carolina
Birth Outcomes and Hospital Choices

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Abstract

The Patient Protection and Affordable Care Act (ACA) is the comprehensive health care reform law that was enacted in March 2010 under the Obama administration. In 2014, the ACA was implemented in North Carolina. The purpose of this study is to examine the impact of the ACA on birth outcomes of expectant mothers. To do this, a difference in difference estimation approach was used to compare the pre-intervention, 1996-2013, and post-intervention, 2014-2017, groups of expectant mothers in North Carolina. The results from this analysis show that the Affordable Care Act decreased birth weight by 29.482 grams and gestation length by 0.0858 weeks and increased the likelihood of a preterm birth by 0.9% and a low birth weight by 0.59%. An increase in 10 minutes of driving time to the birth hospital results in weight in grams decreases by 19.14 grams and gestation length decreases by 3/25 of a week. This also results in an increased risk of low birth weight, very low birth weight, preterm births, and extreme preterm births. The coefficients on the interaction term for preterm and extreme preterm births are negative and significant at the 10% level suggesting the passing of the ACA may improve some birth outcomes for pregnant women who are geographically distant from their birthing hospital. However, the extremely small magnitudes suggest that these health benefits are minimal. These findings highlight that alleviating financial barriers to care neither improves or inhibits reproductive health only to the extent that geographic barriers to care are also surmountable. Implications for healthcare policy are that competing barriers to care (e.g. financial and geographic) must be considered jointly and that the current trend in rural maternity ward closures may undermine the effectiveness of the concurrent trend in Medicaid expansion.

Introduction

The Patient Protection and Affordable Care Act (ACA) is the comprehensive health care reform law that was enacted in March 2010 under the Obama administration. Consisting of 10 separate titles and acts, there are several aims of the act. The primary goal of the act is to achieve near universal coverage and to do so through shared responsibility among government, individuals and employees (Rosenbaum, 2011).

The three primary goals of this law focus on creating health care more accessible and affordable in the United States. The three goals include: make affordable health insurance available to more people, expand the Medicaid program to cover all adults within income below 139% of the federal poverty level, and support innovative medical care delivery methods designed to lower the costs of health care (healthcare.gov). Information about the predicted outcomes and impact of the ACA lists many items but are centered around the legislation providing universal health coverage (Yorkery, 2011; Randolph & Morrow, 2011). Although the ACA was passed in 2010, North Carolina did not adopt the legislation until 2014. Since then, North Carolina is among the nonexpanding states meaning that the legislature has neglected to expand coverage of the ACA. Expanding the coverage of the ACA would increase coverage for a "new adult group". This new adult group continues to include people age 65 and over, those who are eligible on the basis of a disbailtiy or need for long-term services, and now extends eligibility to all adults under age 65 with incomes below 138% of the federal poverty level ("Medicaid expansion to the new adult group"). According to Searing & Ross, states that are non-expansionary states have a more persistent racial maternal and infant health disparities (2019). Medicaid expansionary states have lower disparities and are reducing both mother and infant mortality rates (Searing & Ross, 2019). Although there has been discussion on how the ACA has

affected birth outcomes, such as infant mortality rate, gestational length, and other factors, a concentrated investigation in North Carolina has not been completed.

The ACA has not only impacted the coverage that pregnant women have access to, it has also impacted the amount of prenatal care that expecting mothers receive (Daw & Sommers, 2018). Daw and Sommers used a difference in difference analysis to compare live births from before 2009 and after 2011-2013 (2018). The results of this study indicated that the ACA increased the use of prenatal care and there was also a moderate reduction in the amount of preterm births (2018). From this study we can see that the ACA has been able to increase the amount of coverage that expectant mothers have. Specifically, in North Carolina pregnant women have more access to care and are receiving it with certain variations still occurring in care (Atkinson, 2020).

Not only does insurance coverage affect birth outcomes, travel time and geographic access to care also influence birth outcomes. Rural hospitals around the country are experiencing closures. In the United States fewer than half of all rural counties had hospital obstetric care as of 2014 (Hung, Henning-Smith, Casey, & Kozhimannil, 2017). Due to the large decline in county-level availability of obstetric care in rural areas creates a cause for concern about rural women's access to care (Hung et. al., 2017). Grzybowski, Stoll, and Kornelson completed a study investigating the impact of travel time on 49,402 women carrying a single pregnancy beyond 20 weeks and delivering between April 1, 2000 and March 31, 2004 that linked newborn data with geographic addresses and the nearest maternity services .The authors of this study concluded that rural pregnant women who have to travel to obtain maternity services have increased rates of adverse outcomes and newborns have an increased number of NICU care days (Grzybowski, Stoll, & Kornelson 2011). An additional study also shows that women who are living in rural

areas and who deliver in hospitals outside the community are more likely to have a complicated labor and preterm delivery (Nesbitt, Connell, Hart, & Rosenblatt, 1990). Other factors that rural women may face include living in communities without obstetrical services that must travel to obtain prenatal care and increased stress associated with travel and parturition in unfamiliar settings could interfere in the labor process (Nesbitt, Connell, Hart, & Rosenblatt, 1990).

Not only will this paper the impact of the ACA on birth outcomes, specifically preterm births, and hospital choices of pregnant women in North Carolina from 1996-2017 it will also explore the impact of geographic location on these outcomes as well. The data used in this study will be further explained in the following section. To analyze the data a difference in difference method will be used and the regressions used will be explained in the methods section. The results section will address the findings from the regressions used in the difference in difference analysis. The final section of this paper will discuss the impact of the findings.

Data

North Carolina State Center for Health Statistics data on over 3 million pregnant women who gave birth with associated birth outcomes from 1996-2017 were used. The variables that were used from this data set include birth year, state, county of birth, birth weight including both low and very low birth weight, and gestation length including both preterm and extreme preterm births.

Birth year is defined as the year of birth. State of birth is defined as the geographic state of birth. The sample is limited to only North Carolina births. County of birth is defined as the county in North Carolina of birth. Residential address is also included in the data set to measure the drive time from the woman's home to the birth hospital. Birth weight is defined as the weight

that the infant measured at birth, which was converted to grams to be consistent with the fetal origins literature. Birth weight was calculated by multiplying the birth weight in pounds by 453.592 and ounces by 28.349 in order to convert the weight to grams. Two other variables very low birth weight and low birth weight, were also included.   Very low birth weight is defined as a weight less than 1500 grams (Jukic, Baird, Weinberg, McConnaughey, & Wilcox, 2013). Very low birth weight is a binary indicator with a value of one if the birth weight <1500 grams and zero otherwise. Low birth weight is defined as weight between 1500 and 2500 grams (Jukic et. al., 2013). Low birth weight is a binary indicator variable that took on the value of one if the birth weight > equal to 2500 grams and zero otherwise.

Gestation length is defined as the amount of time from conception to birth that a woman is pregnant. Typically, gestation length is around 280 days (Jukic et. al., 2013). A non-viable birth is defined as a birth less than 22 weeks. Non-viable births were excluded in this study. Gestation length was included a binary indicator that took on the value of one if the gestation length was greater than 26 weeks and zero otherwise. An extreme preterm birth is defined as a birth of less than 34 weeks of gestation length or 238 days. Extreme preterm births is a binary indicator that takes on the value of one if the clinical gestation length is less than 34 weeks and zero otherwise. A preterm birth is defined as a birth of less that 37 weeks of gestation length or 259 days. Preterm births is a binary indicator that takes on the value of one if the clinical gestational length was less than 37 weeks and zero otherwise.

Three independent variables were used in this difference-in-difference analysis. First, hospital of birth drive time is defined as the time in minutes that it took for each pregnant mother to travel to the hospital, she gave birth at from her residential address. Second, the post variable defines the year that North Carolina adopted the Affordable Care Act and the years following.

Birth outcomes from 1996-2013 serve as the pre-intervention group, whereas, birth outcomes

from 2014-2014 serve as the post-intervention group or treatment group. Specifically, the post

variable represents 2014-2017 in this data set. The post variable is a binary indicator equaling

one if the birth occurred after 2013 and zero otherwise. The variable named dt_post is the

interaction between the post and hospital drive time variables. Dt_post was calculated by

multiplying the hospital drive time by the post variable. The following section examines the

equations were regressed using a difference-in-difference method using the variables listed

above.

Table 1.

Birth Outcomes	Definition	Units of Measurement
Birth weight	Characterized as the vector of vector of birth weight of the infant for mother i, in zipcode z, during month m, and year t	Grams
Gestation length	Characterized as the vector of gestation length for mother i, in zipcode z, during month m, and year t.	Grams
Low birth weights	Characterized as the vector of birth weight of the infant between 1500 and 2500 grams for mother i, in zipcode z, during month m, and year t.	Grams
Very low birth weights	Characterized as the vector of birth weight of the infant $<$ 1500 grams for mother i, in zipcode z, during month m, and year t	Weeks
Preterm birth	Characterized as the vector of gestation length <37 weeks for mother i, in zipcode z, during month m, and year t.	Weeks
Extremely preterm birth	Characterized as the vector of gestation length <34 weeks for mother i, in zipcode z, during month m, and year t.	Weeks

Note: The above table details the variables used in the difference-in-difference model.

Methods

A difference-in-difference (DD) methods was used to estimate the effect of the

Affordable Care Act (ACA) on birth outcomes using longitudinal data. The following estimating

equation was used as the basis for the analysis.

$$b_{i,z,m,t} = \beta_0 + \beta_1 D_{i,z,m,t} + \beta_2 Post + \beta_3 D_{i,z,m,t} Post + \beta_4 \tau + \beta_5 m + \beta_6 z + \epsilon_{i,z,m,t} \quad (\textbf{\textit{Eq.}}$$

1)

The variable $b_{i,z,m,t}$ is characterized as the vector of birth outcomes for mother i, in

zipcode z, during month m, and year t. β_0 represents the estimated intercept. The variable $D_{i,z,m,t}$

is the driving time to the hospital of birth for mother i, in zipcode z, during month m, and year t.

The variable $Post$ is defined as 1 if $t>2013$ and 0 otherwise, which corresponds with the North

Carolina implemenetaton of the ACA. The variable $D_{i,z,m,t} Post$ the post ACA passing and drive

time interactive effect. The variables τ, m and z is captures fixed effects at the year, month and

zipcode levels. The variable $\epsilon_{i,z,m,t}$ is characterized as the stochastic error term.

To estimate the causal effect of the ACA on birth outcomes, a vector of six dependent

variables were analyzed. These variables include: grams, low birth weight, very low birth

weight, gestation length, preterm birth, and extreme preterm birth. Each of these variables is

further defined in *Table 1*

The primary coefficients of interest are $\beta_1, \beta_2,$ and β_3. For birth weight and gestation

length, my first null hypothesis is that increased travel time to the birth hospital will decrease

birth weight and gestation length, $b_1 < 0$, against the alternative hypothesis that driving time has

a non-negative impact on birth weight and gestation length, $\beta_1 \geq 0$. The expectation of

abbreviated pregnancies lead to my second hypothesis that increased travel time to the birth

hospital will increase the likelihood of preterm, extremely preterm, low birth weight and

extremely low birth weight outcomes, $\beta_1 > 0$, against the alterantive hypothesis that driving time

has a negative impact on these birth outcomes, $\beta_1 \leq 0$.

For low birth weight, very low birth weight, preterm birth and extreme preterm birth my

first null hypothesis is that after the ACA was passed the likelihood of having a child with a,

very low birth weight, preterm birth and extreme preterm birth will decreases, $\beta_2 < 0$, against

the alternative hypothesis that the passing of the ACA has a non-negative impact on these birth

outcomes, $\beta_2 \geq 0$. The expectation of lessened preterm births lead to my second hypothesis that

the passing of the ACA increased birth weight in grams and gestation length, $\beta_1 > 0$, against the

alternative hypothesis that the passing of the ACA has a negative impact on birth weight in

grams and gestation length, $\beta_2 \leq 0$.

For birth weight in grams, gestation length, low birth weight, very low birth weight,

preterm birth and extreme preterm birth, my null hypothesis is that increasing the time of travel

will begin to eliminate some of the health benefits from expanded insurance coverage, $\beta_3 < 0$,

against the alternative hypothesis that increasing the time of travel will begin to enhance some of

the health benefits from expanded insurance coverage, $\beta_3 \geq 0$. The following section will

discuss the findings from the DD model estimations for each of the six dependent variables.

Results

Analysis of the North Carolina data shows that there is a relationship between the passage

of the ACA and birth outcomes in North Carolina. ***Table 2.*** shows the results from the DD model

estimations for *Eq.1* including each of the six dependent variables. Estimates of the coefficients

shows a statistically significant impact of increasing drive time on birth outcomes. A 10-minute

increase in drive time to the birth hospital is associated with each of the following birth outcome

results. This shows that birth weight in grams decreases by 19.14 grams and gestation length

decreases by 3/25 of a week. This also shows that the likelihood of having a low birth weight

increase by 1.4% and g a very low birth weight increase by 5.1%. The likelihood of having a

preterm birth increases by 1.6% and an extreme preterm birth increases by 1.1%. This finding

suggests that increasing the drive time to the birth hospital would not improve these birth

outcomes.

Estimates of the post variable show statistically significant coefficients for birth weight,

low birth weight, gestation length, and preterm births at the 1% level. After the passing of the

ACA, birth weight in grams decreased by 29.482 grams and gestation length decreased by

0.0858 of a week. The likelihood of a low birth weight increased by 0.59% and a preterm birth

increased by 0.90%. The results suggest that the ACA had a negative impact on gestation length

and birth weight and the impact on preterm births and low birth weight is not statistically

different from zero. These findings suggest that the passing of the ACA did not improve these

birth outcomes.

Estimates on the interaction term reveal a statistically insignificant coefficient that is

close to zero in magnitude. This null result suggests that the ACA is unable to mitigate the

impaired birth effects that arise from geographic barriers to accessing maternal care. The

coefficients on the interaction term for preterm and extreme preterm births are negative and

significant at the 10% level. This finding suggests the passing of the ACA may improve some

birth outcomes for pregnant women who are geographically distant from their birthing hospital.

However, the extremely small magnitudes suggest that these health benefits are minimal.

One limitation of this study is that racial and socioeconomic status could not be linked

with mothers in this study. Without this information we are unable to link any birth outcomes

with these features comparisons across race and socioeconomic status could not be made.

Table 2. Estimation results for the impact of the ACA on birth outcomes

	Birth Weight (g)	Low Birth Weight (<2500g)	Very Low Birth Weight (<1500g)	Gestation Length (wks)	Preterm Birth (<37 wks)	Extreme Preterm Birth (<34 wks)
Drive Time	-1.914*** (0.687)	0.0014*** (0.0004)	0.0051*** (0.687)	-0.0125*** (0.0033)	0.0016*** (0.0004)	0.0011*** (0.0028)
Post	-29.482*** (3.839)	0.0059*** (0.0018)	0.0001 (0.687)	-0.0858*** (0.0183)	0.0090*** (0.0022)	0.0020 (0.01547)
Drive Time *Post	0.308 (0.189)	-0.0012 (0.0001)	-0.00007 (0.00005)	0.0013 (0.0009)	-0.00001* (0.00001)	-0.0002* (0.0001)
N	2,460,024	2,460,024	2,460,024	2,460,024	2,460,024	2,460,024
R_2	0.0101	0.0125	0.0114	0.0182	0.0127	0.0214
Constant	3364.475	0.0443	-0.0045	39.044	0.1349	-0.0028
County FE	X	X	X	X	X	X

Note: Only mothers that had a clinical gestation length of >22 weeks were included. Each county in North Carolina was given a specific identficaiton number corresponsding 1-100. County fixed effects are included for all specifications. Standard errors are clustered at the county level. *p<0.10, **p<0.05, ***p<0.01.

Discussion

The Affordable Care Act's passing in 2014 has increased access to care for vulnerable

North Carolina populations, such as pregnant women, but disparities still remain (Atkinson,

2020). The phenomenon of rural hospital closures has been taking place throughout the United

States and in North Carolina. Closures of rural hospitals have been attributed to pregnant women

traveling outside of their local community in order to receive prenatal and obstetric services

(Nesbitt, Connell, Hart, & Rosenblatt, 1990). Not only do these women have to travel outside

their local community to receive services, if they choose not to travel the delivery of their child

will more than likely be done by a general or family physician (Nesbitt, Connell, Hart, &

Rosenblatt, 1990). Regardless of their insurance status, the lack of services that these women have access to has been shown to increase the number of complications experienced during labor and premature deliveries (Nesbitt, Connell, Hart, & Rosenblatt, 1990).

The first finding from the DD model suggest that alleviating financial barriers to care neither helps or impairs birth outcomes. The estimates of the data show that the ACA had a significant negative impact on birth weight, low birth weight outcomes, gestation length and preterm births. This finding could be because that although more women have access and are covered by insurance their insurance might not be taken in their area causing them to travel to other locations to receive care. However, the finding from the interaction variable show that

The second finding from the DD model suggests that increasing geographic barriers to care impair birth outcomes. As travel time increases each of the six birth outcomes worsened. This could be attributed to the increase stress that a pregnant woman goes through when trying to find care beyond their own community. This could also be attributed to the lack of rural hospitals and clinics to give care to these women.

The final finding from the DD model suggests that the ACA is unable to mitigate the impaired birth effects that arise from geographic barriers to accessing maternal care. One reason for this might be that although these women now have the financial access to care, the geographic barriers are too large to overcome. With the closest hospital being far from their residential address, many of these newly insured women might not have the means to travel long distances to receive care.

In North Carolina rural hospital closures are defined as rural hospitals that close their inpatient service or move their services fifteen or more miles away from the present location (NC Rural Health Research Program). Patients in these areas are traveling 5 to 30 miles to access

inpatient care with 43% of the closed hospitals being more than 15 miles to the next nearest hospital (Clawar, Thrompson, & Pink, 2018). Trends in these closures can be attributed to many rural areas losing population which decreases the market for local hospitals and other businesses. Other reasons for closures includes hospital systems consolidating and merging toward value-based payment changes in how rural hospitals operate as well as changes in technology and healthcare. State and federal policies also can be attributed to hospital closures. Items like the Affordable Care Act and whether or not the state has expanded Medicaid and Medicare payment policies has positively and negatively affected hospital margins (NC Rural Health Research Program). Each of these reasons should be taken into consideration when trying to understand the trends of rural hospital closures in North Carolina.

Understanding that state and federal policies have influence on rural hospital closures and birth outcomes is important to realize. Impaired birth outcomes result in both economic and emotional costs for families and country (Bick, 2012). Data from the U.S. estimates costs associated with preterm births are around $26.2 billion dollars a year with these costs being directly associated with gestational age at birth (Institute of Medicine, 2007). By realizing that the implications of impaired birth outcomes go beyond the emotional cost of mothers it is important to consider the direct economic costs that could be prevented by reducing these outcomes. Implications for healthcare policy are that competing barriers to care (e.g. financial and geographic) must be considered jointly and that the current trend in rural maternity ward closures may undermine the effectiveness of the concurrent trend in Medicaid expansion.

Acknowledgements

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