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The Effect of Prenatal Care and Other Factors on Preterm Births in Montgomery County 2007-2009

Leslie A. Schmieder
Wright State University - Main Campus

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Leslie A. Schmieder
Wright State University
Master of Public Health
Culminating Experience

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Abstract

Introduction Preterm birth is defined as a baby who is born before 37 weeks of pregnancy. Problems with preterm birth include an increased risk for health complications throughout life as well as having significantly more medical expenses compared to a full term infant. Prenatal care has shown to decrease the risk for preterm birth nationally. The objective of this project was to analyze prenatal care and other risk and demographic factors to determine their association with preterm birth in Montgomery County. **Method** Data used included the 2007-2009 Montgomery County Birth Certificate Data for mothers who had singleton births. The Kessner Index was used to assess the adequacy of prenatal care. Finally, a logistical regression was conducted to determine significant associations between demographic and risk factors with preterm birth. **Results** The significant risk factors for preterm birth in Montgomery County included: lower education, prenatal diabetes, prior preterm birth, older maternal age, and African American race. Those who did not have adequate prenatal care were also more likely to have a preterm birth than a full term birth. **Conclusion** Overall results of the Kessner index showed that 98.89 % utilized an adequate amount of prenatal care, 0.72% were classified as using an intermediate amount of prenatal care and 0.39% had utilized an inadequate amount of prenatal care. Other findings were consistent with other research except that smoking status, while a risk factor, was not a significant risk factor; this should be researched further. In addition, since inadequate prenatal care was a risk factor for preterm birth, more research is warranted into determining reasons why mothers may not utilize prenatal care.

Introduction

Preterm birth is defined as a baby who is born before 37 weeks of pregnancy. In 2006, prematurity and low birth weight (<2500 g) accounted for 17% of all infant deaths in the United States. It is the number one cause of infant mortality in the United States. In addition, preterm infants are also at an increased risk of health complications including breathing problems, intestinal issues, and neurological deficits. There is also increased risk of long-term disabilities including intellectual deficits, behavioral problems, cerebral palsy, vision loss and hearing loss (Prematurity Research). It is not only problematic emotionally for the family involved, it is also burdensome financially for both the family and the economy. According to the March of Dimes, in 2009 the average medical costs for a preterm baby were more than 10 times higher than when a woman had a healthy full-term infant. The average costs for preterm infants and full-term infants were $49,033 and $4,551 respectively (Preterm Birth Overview). Identifying risk factors allow public health and medical professionals to focus on specific interventions that will help to prevent the occurrence of preterm birth, which is problematic for both families as well as our health care system.

There are various risk factors for preterm birth, some have been found to be highly correlated with the risk of preterm birth, while others are only mildly to moderately associated with preterm birth. Maternal health conditions and pregnancy related problems which increase the risk for preterm birth include gestational diabetes, a history of preterm delivery, plurality (multiple births in a single pregnancy), and hypertension, diabetes, and prenatal infection. Social and biological factors that can put a mother and her baby at risk for preterm delivery are African American ethnicity, multiple births, an underweight or overweight mother, a maternal age younger than 16 or older than 35, lack of prenatal care, low socioeconomic status, unmarried status, and tobacco use. This study will assess documented risk factors that have been shown to

have at least a moderate correlation with preterm birth and that are available on the birth certificate.

Statement of Purpose or Research Question

There are numerous research studies showing that prenatal care is beneficial for the treatment of obstetric conditions including hypertension and diabetes. It has also shown to be a cost-effective way to prevent long-term health problems for the mother and infant. However, little data is available on the direct benefit to reducing the likelihood of a preterm birth (Krueger & Scholl, 2000). In addition, the research that has been conducted is outdated. Given that prenatal care has changed due to technological advances as well as breakthroughs in research, it is important to show the current relationship between prenatal care and its relationship to preterm birth rates. The purpose of this research is to evaluate the effect of prenatal care on the likelihood of a mother having a preterm birth infant (<37 weeks) or a full term birth infant (37 weeks +) in Montgomery County from 2007-2009. Additional risk factors that will be included in the analysis include previous preterm birth, plurality, hypertension, diabetes, prenatal infections, maternal age, race, socio-economic status, marital status, maternal weight, and smoking status of the mother.

Review of Literature

The goal of this research is to establish whether there is a direct relationship between the utilization of prenatal care and preterm birth. Therefore, it is important that we look at the many risk factors related to preterm births to try to reduce the effect of any confounding variables that may alter the data analysis. The risk factors for preterm birth can be broken up into two categories: 1) Medical Risk Factors and 2) Social and Demographic Factors. **Table 1**, below, outlines these categories:

Table 1.

Medical	Social/ Demographic
Previous Preterm Birth	Age
Plurality	Race
Hypertension	Socioeconomic Status
Diabetes	Weight
Infection	Smoking Status
	Marital Status
	Prenatal Care
	Study Population

Medical Risk Factors

Previous preterm birth

Previous preterm birth is an established risk factor for preterm birth. More specifically, most researchers agree that having a previous preterm birth highly increases the risk for a mother to have a recurrent preterm delivery. In The Epidemiology of Preterm Labor assessment conducted by Robinson, Regan, and Norwitz (2001) the authors explained that many women who have had preterm deliveries can go on to have other full term pregnancies. However, multiple studies have shown that women with previous spontaneous preterm birth have a significantly increased risk of preterm delivery in their current pregnancy. One study found that a previous preterm birth was the highest risk factor associated with a current gestational preterm birth. They indicated that a prior preterm birth increased risk of another preterm birth by 2.5 times versus those with no prior preterm birth (Robinson, Regan & Norwitz, 2001).

While noting that many women who have had preterm deliveries can later have full term pregnancies, Robinson et al. (2001) found that a previous preterm birth was the highest risk factor associated with a current gestational preterm birth. They indicated that a prior preterm birth increased risk of another preterm birth by 2.5 times versus those with no prior preterm birth. Other studies have also shown that women with previous spontaneous preterm birth have a significantly increased risk of preterm delivery in their current pregnancy.

Plurality

Plurality, or multifetal gestation, has shown to be a significant risk factor for preterm delivery (Robinson et al., 2001). Thirteen percent of all preterm births and fifteen percent of all early preterm births are due to plurality. There are multiple reasons that plurality increases risk for preterm delivery. First, multiple pregnancies increase the amount of circulating estrogen and progesterone, which is known to increase the risk of preterm births. Also, there are physical complications with plural births relating to the uterus. The complications most closely connected with preterm birth are uterine distension and cervical incompetence (weakened cervix). These problems can make it challenging for a mother to carry to full term.

Plurality is also increasing in prevalence and thus is continuing to become a more significant risk factor. In 1997 the rate of triplet and higher multiple births in the United States increased significantly to 147 per 100,000 from the 1980 rate of 37 per 100,000 (Robinson et al., 2001).

Hypertension

Hypertension (high blood pressure) during pregnancy is an established risk factor for multiple negative birth outcomes including preterm birth (Ray, Burrows, Burrows, & Vemeulen, 2001). However, the specific relationship of hypertension and preterm birth has not been well

studied. Some research reviews do not include it as a risk factor while some others do (Ray et al., 2001). A study conducted by Ray, Burrows, Burrows, and Vemeulen (2001) compared multiple types of hypertension and each type's relative risk for negative birth outcomes. All of the types of hypertension (gestational, chronic, preeclamptic, and chronic with preeclampsia) demonstrated a significantly increased odds ratio and rate of preterm birth, but. The data showed that the rate and risk of preterm birth before 32 weeks was highest among the mothers who were preeclamptic, and those who had chronic hypertension in addition to preeclampsia (Ray et al., 2001).

Diabetes

Diabetes has been shown to lead to several postnatal complications including respiratory distress syndrome, hypocalcaemia, hypoglycemia, and preeclampsia, but its relationship with preterm birth is essentially inconclusive (Hedderson, Ferrara, & Sacks, 2003). However, Hedderson, Ferrara and Sacks (2003) also found that the risk of preterm birth went up with increased levels of pregnancy glycemia.

Infection

Multiple types of intrauterine infections have been researched and shown to have a strong relationship with preterm birth. Specifically, intraamniotic infection, chorioamnionitis (inflammation of fetal membranes), endometriosis, and genital tract infections have all been shown to increase likelihood of preterm births (Berkowitz & Papiernik, 1993). However, there is limited data on the relationship of systemic infections such as influenza, measles, hepatitis, and malaria with the risk of preterm birth. In addition, research has not been able to show that the identification and treatment of infections will prevent preterm delivery (Berkowitz & Papiernik, 1993).

Social and Demographic Factors

Age

Advanced maternal age (35 years or older) and the delaying of childbearing in industrialized countries has been increasing in the past 20 years. From 1970 to 2001, the rate of women 35-39 giving birth doubled (Newburn-Cook & Onyskiw, 2005). Currently, 13% of all births In the United States are from women aged 35 or older (Newburn-Cook & Onyskiw, 2005). Therefore, it is important to see if delayed childbearing could be a risk factor for preterm birth. So far, the research has shown that advanced maternal age as an independent risk factor for preterm birth is inconclusive. A meta-analysis conducted in 2005 examined ten studies from 1985 to 2002 and found that most studies showed older maternal age to be associated with preterm birth. However, the authors noted that a limitation to these studies was that they failed to show if age was an independent or a direct risk factor. They believed more research is needed because the relationship of maternal age and preterm birth may have been confounded by other related risk factors that many studies did not account for (Newburn-Cook & Onyskiw, 2005).

Younger maternal age, on the other hand, has shown to be at least a moderate risk factor for preterm birth. More specifically, those mothers who are less than 20 years old and especially those less than 18 years old have shown to be at greater risk for preterm birth. One large study demonstrated that women younger than 18 had an increased risk of preterm birth before 32 weeks with an odds ratio of 1.41 (Robinson et al., 2001). Other research has also indicated that in multiparious women and teenagers that the younger the age, the greater the risk of preterm birth (Robinson et al., 2001).

Race

African American race has shown to be a significant and established risk factor for preterm birth as well as for multiple negative perinatal outcomes. Most studies have shown the risk of preterm birth in African Americans to be two times that of the white population (Robinson et al., 2001). Other negative perinatal outcomes that have higher incidence rates in the African American population include an increased risk of low birth weight, very low birth weight, and infant death (Dominguez, Christine, Glynn, Calvin, & Sandman, 2008).

Most recently, the rates in the United States for preterm birth were 17.8% and 11.5% for African Americans and European races, respectively (York, Strauss III, Neal, & Eaves, 2010). Although the reason for this difference is not completely known, African Americans have higher rates per capita of health risk factors including diabetes, obesity, high blood pressure, and high cholesterol. They are also at higher risk for negative birth outcomes including infant mortality, low birth weight, and prematurity. According to the March of Dimes (2010), the infant mortality rate in the United States was highest for African American infants at 13.1 per 1,000 live births while the rate of infant mortality for Caucasians was only 5.7 per 1,000 live births (PeriStats: Infant Mortality, 2006). An analysis conducted by York, Strauss II, Neal, and Eaves (2010) concluded that although both fetal and maternal genetic factors differ between race categories, to understand the differences in African American and Caucasian preterm deliveries it is important to address differences in the sociological and cultural sources and their possible relationship to the genetic differences between the races (York et al., 2010).

Socio-economic status (SES)

Low socioeconomic status is an established risk factor for preterm birth (Berkowitz & Papiernik, 1993). However, like older maternal age, low socioeconomic status and its

relationship to preterm birth is most likely a complex mixture of factors including education, marital status, transportation, and smoking status, among others. A study conducted in 2009 showed that high county-level poverty was significantly associated with preterm birth risk (DeFranco, Lian, Muglia, & Schootman, 2008). Conversely, a study done in 2010 in South Carolina using the Pregnancy Risk Assessment and Monitoring System (PRAMS) survey showed that mothers living in high and medium income inequality neighborhoods were at increased risk of having a low birth weight baby, but were not significantly at an increased risk for delivering a preterm infant (Nkansah-Amankra, Dhawain, Hussey, & Luchok, 2010). Most studies show that low SES is a risk factor for preterm birth due to lack of access to care, poor nutrition, lower education, and other factors that are cyclically related to having few resources.

Weight

The research regarding the pre-pregnancy weight of the mother has been researched to some extent but the results of this research show mixed findings on its relationship to preterm birth. A large analysis of the research done by Berkowitz and Papiernik (1993) show that some studies do show a higher risk for preterm birth for either low pre-pregnancy weight or low pre-pregnancy BMI (BMI <19.5) after accounting for confounding variables. However, others do not find this to be a statistically significant risk factor (Berkowitz & Papiernik, 1993).

Other research has addressed low maternal weight gain and its relationship to preterm birth. Low maternal weight gain has been demonstrated to be significantly correlated with preterm birth (Berkowitz & Papiernik, 1993). However, some researchers discovered that once the weight of the infant at birth was subtracted, the difference became non-significant (Berkowitz & Papiernik, 1993). In addition, researchers hypothesize that low pregnancy weight gain may be a symptom rather than a cause of preterm birth (Berkowitz & Papiernik, 1993).

Obesity in pregnancy and its relationship to preterm birth has not been well studied. That being said, the research that has been done has shown a significantly increased risk for preterm birth in women who are obese. In 2007, a study conducted in the United Kingdom showed that obese women with a BMI of 30-34.9 were at increased risk for multiple harmful natal and perinatal complications, including: preterm birth, pre-eclampsia, gestational hypertension, macrosomia (newborn with excessive birth weight), and caesarian delivery (Bhattacharya, Campbell, Liston, & Bhattycharya, 2007).

Smoking status

Adults who smoke are at increased risk for serious health concerns including heart disease, cancer, lung disease, and stroke. In pregnant women who smoke the problems can translate into problems for the baby including birth defects, low birthweight, underweight, placental problems, and stillbirth (Alcohol and drugs:Smoking during pregnancy, 2010).

Smoking status of the mother has been demonstrated to increase the risk of preterm birth (Robinson et al., 2001). Of all the risk factors, smoking status has one of the strongest correlations with preterm birth. The actual risk increases as the amount that the mother smokes increases. In other words, there is a dose dependent relationship between smoking status and preterm birth. The consumption of 1 to 9 cigarettes per day has an OR of 1.1 for preterm births between 33 and 36 weeks and an OR of 1.3 for births at or before 32 weeks (Robinson et al., 2001).

Marital status

There is little direct research on the effect that marital status has on the risk for preterm birth. However, unmarried status has been shown to increase risk for poor birth outcomes including infant mortality and low birthweight (Bird, Chandra, Bennett, & Harvey, 2000). Since the relationship between preterm birth, low birth weight, and infant mortality, is so strong it is important to address any factor that could be a potential risk factor for preterm birth, including marital status. Since 1980, nonmarital childbearing has increased by almost 15% (Bird et al., 2000). Although most research does show a relationship between birth outcomes and marital status, researchers also recognize that there are some confounding variables that may affect data. Specifically, most studies conclude that marital status may be dependent on maternal race, age, and education. In addition, cohabitation of unmarried parents may have a significant effect on research. There is minimal research on cohabitation and pregnancy effects in the United States but those done in other countries have shown there to be no difference in low birth weight risk in cohabitative pregnant women versus their married counterparts (Bird et al., 2000).

Prenatal care

The relationship of inadequate or no prenatal care to preterm birth has been well studied, but so far, there has not been a lot of conclusive evidence either way. There is much research showing that prenatal care has a relationship in reducing the risk of multiple adverse postnatal outcomes such as neonatal mortality, low birth weight, and infant health problems. The research that has been done on preterm birth and prenatal care, although somewhat dated, has shown that there is an increased risk of preterm birth with lower amounts of prenatal care (Chen, Wen, Yang, & Walker, 2007). A study conducted in 2000 in New Jersey used the Kessner Index and Kotelchuck Index to determine the adequacy of prenatal care with regards to preterm birth. The

results indicated that regardless of which index was used inadequate prenatal care was associated with an increased risk of preterm birth (Krueger & Scholl, 2000). In 2007, a study conducted on the risk of neonatal mortality and prenatal care showed that inadequate prenatal care was a risk factor for neonatal death. The conclusions from this study indicated that neonatal mortality was most likely mediated by preterm birth and low birth weight (Chen et al., 2007).

Study population

Montgomery County is located in southwestern Ohio and is the population from which data was collected. According to 2009 US Census Bureau data the population of Montgomery County is 532,562; 74.5% of the population is non-Hispanic white and 20.3% is African American. The median household income of Montgomery County is $45,237 and 15% of the population is living below the poverty level (U.S. Census Bureau, 2009).

Methods

A Wright State University Internal Review Board (IRB) Petition for Approval of Research Involving Human Subjects was submitted under 45 CFR 46.101. An exempted status was approved by the IRB under the number four category for research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens.

Montgomery County, Ohio 2007-2009 birth certificate data was used for the data analysis. This data includes all women who had singleton births during the specified aforementioned time period. Multiple births were excluded from the study as multiple births have such a high correlation with preterm birth and may skew the data and how it relates to the effect prenatal care has on preterm birth. Data sets that had insufficient data on gestational age had to also be excluded from the study. However, the latter data sets were accounted for in the statistical analysis. A descriptive analysis of the prevalence of demographic variables, risk factors, and preterm birth was conducted. A list of these demographic variables and risk factors

is given in Table 1. For the purposes of this research, the following information from the birth certificates was used to analyze the risk factors for preterm birth in the population: mother's education, father's education, how the mother paid for the visit (i.e. Medicaid, private insurance, etc.), WIC status (whether or not the mother used WIC before or during pregnancy), smoking status (if the mother smoked at any time during the pregnancy), prenatal diabetes, gestational diabetes, prior preterm birth, age of the mother, race of the mother, marital status of the mother. To analyze prenatal care the following information from the birth certificate was used: month which prenatal care began, how many prenatal care visits were made, and gestational age of the baby at birth.

Each birth was evaluated for adequacy of prenatal care using the Kessner Index (see Figure 1). The Kessner Index gives a rating that is based on the number of prenatal visits and when prenatal care began for the mother. For example, if a woman carried to 32 weeks gestation and had seven prenatal visits her prenatal care would be rated "adequate". Finally, a logistical regression model was used to assess the association between preterm birth and known risk factors. Odds ratios and confidence intervals were calculated to show the odds of women having a preterm birth for each risk factor.

Results and Data Analysis

From 2007-2009 in Montgomery County there were 20,674 singleton live births recorded in Montgomery County, OH. Of those births, 15,789 had sufficient information regarding gestational age and were used in the data analysis. The population consisted of 71.13% white mothers, 26.08% African Americans, and 2.80% mothers that were in another racial category than white or African American. Of those pregnancies, 10.59% of mothers delivered a preterm baby, and 89.41% delivered full term infants.

The Kessner Index results showed that 98.89 % utilized an adequate amount of prenatal care, 0.72% were classified as using an intermediate amount of prenatal care and 0.39% had utilized an inadequate amount of prenatal care (Table 2).

Table 2. Utilization of Prenatal Care in Montgomery County 2007-2009 based on the Kessner Index

Adequate Prenatal Care	Intermediate Prenatal Care	Inadequate Prenatal Care
98.89%	.72%	.39%

A logistical regression was utilized to analyze the data. The results of the statistical calculations demonstrate that there were six significant risk factors for preterm birth. These factors include: mothers who had less than high school education, fathers who had only a high school education, unmarried mothers, mothers who had prenatal diabetes, mothers who had a prior preterm birth, mothers who were over the age of 35, and mothers who were African American. The three most significant risk factors were prior preterm birth, a mother over the age of 35, and a mother of African American race (Table 3).

For women who had prior preterm births, 25.76% had a subsequent preterm birth as opposed to only 9.91% of mothers who did not have a prior preterm birth. Also, of the mothers over the age of 35, 13.6% delivered preterm babies as compared to mothers from ages 20-35 where only 10.04% had preterm births. Lastly, 14.82% of African American mothers had a preterm child, while only 9.15% of white mothers delivered preterm babies (Table 3).

Conversely, although a higher percentage of smokers than non-smokers delivered pre-term, the increased risk was not significant. Also, mothers under the age of 20 were not at an increased risk of having a preterm birth. Lastly, although African American race was a risk

factor, other races than white or African American were not at an increased risk for preterm birth.

Prenatal care appears to have an association with the risk of preterm birth (Table 3). For mothers with adequate prenatal care, 10.38% had a preterm infant. This is opposed to mothers with inadequate care, in which 50.82% delivered preterm babies. In fact, mothers with inadequate prenatal care were more likely to deliver preterm than to deliver full term, as only 41.18% of the mother's with inadequate care delivered full term infants.

Table 3. Demographics of parents and the risk of preterm birth, Montgomery County 2007-2009

Risk Factors	**Singleton Live Births**			
	Preterm		**Full Term**	
	n	%	n	%
Pre- Pregnancy Diabetes				
Yes	28	18.54	123	81.46
No	1,633	10.48	13,946	89.52
Gestational Diabetes				
Yes	117	11.63	889	88.37
No	1,544	10.49%	13,180	85.51
Prior Preterm Birth				
Yes	169	25.76	488	74.39
No	1,495	9.91	13,584	90.09
Race				
White	1,027	9.15	10,203	90.85
African American	610	14.82	3,507	85.18
Other	35	7.92	407	92.08
Marital Status				
Married	699	8.46	7,566	91.54
Not Married	973	12.93	6,551	87.07
Mother's Age (years)				
Under 20	233	12.30	1,661	87.70
20-35	1,274	10.04	11,409	89.96
>35	165	13.61	1,047	86.39
WIC Status				
Yes	760	11.39	5,915	88.61
No	903	9.95	8,176	90.05
Smoking Status				
Smoker	306	13.05	2,039	86.95
Non Smoker	1,366	10.17	12,072	89.83
Method of Payment				
Medicaid	824	12.75	5,637	87.25
Private	687	8.91	7,026	91.09
Other	133	9.10	1,328	90.90
Mother's Education				
< H.S.	376	13.91	2,327	86.09
H.S.	492	12.08	3,582	87.92
>H.S.	801	8.90	8,194	91.10
Father's Education				
<H.S.	193	11.82	1,440	88.18
H.S.	465	11.38	3,622	86.62
>H.S.	582	8.14	6,567	91.86
Prenatal Care				
Adequate	1,620	10.38	13,994	89.62
Intermediate	21	18.42	93	81.58
Inadequate	31	50.82	30	41.18

H.S.=High school; percentages based on (n/the total of preterm and full term for the specific category)

Odds ratio estimates (Table 4) show mothers in specific risk factor categories are at increased risk to have a preterm infant. Specifically, those at risk include mothers who are African American, have prenatal diabetes, are in the higher age category (over 35), and have less than a high school education. When the father of the child had a high school education, the mother was also at greater risk for preterm birth. Interestingly, mothers who smoked were not at an increased risk for preterm birth in this population, and those with gestational diabetes were not at increased risk.

Table 4. Odds Ratio Estimates of risk factors for preterm birth in singleton deliveries, Montgomery County 2007-2009

Risk Factors	OR*(95% CL*)
Pre Pregnancy Diabetes Vs. None	1.813 (1.112, 2.955)
Gestational Diabetes Vs. None	1.234 (.988, 1.542)
Prior Preterm Birth Vs. None	3.115 (2,511, 3.865)
African American Race* Vs. White	1.525 (1.311, 1.774)
Other Race Vs. White	.957 (.656, 1.396)
Not Married Vs. Married	1.206 (1.031, 1.410)
Age <20 years Vs. Age 20-35	.863 (.686, 1.086)
Age >35 years vs. Age 20-35	1.507 (1.237, 1.835)
No WIC* vs. WIC	1.149 (.983, 1.343)
Smoker Vs. Non-Smoker	1.177 (.984, 1.408)
Medicaid Vs. Private Insurance	1.038 (.874, 1.233)
Other Payment Method Vs. Private Ins.	.912 (.728, 1.142)
Meduc* <H.S.* Vs. >H.S.	1.312 (1.054, 1.632)
Meduc H.S. Vs. >H.S.	1.163 (.991, 1.366)
Feduc *<H.S. Vs. >H.S.	1.197 (.959, 1.494)
Feduc H.S. Vs. > H.S.	1.227 (1.053, 1.431)

Note. P<.05; OR=Odds Ratio; CL=Confidence Limit; H.S.=High School; WIC=Women, Infants, and Children, Race= Mother's race; PC=Prenatal Care; Meduc=Mother's Education; Feduc=Father's Education

Within the variables analyzed groups, according the Kessner Index results the minimum percentage of use of adequate prenatal care was 94.96%, the median was 98.88%, and the maximum was 100%. In addition, the minimum for the utilization of inadequate prenatal care was 0%, the median was 0.37%, and the maximum was 1.86% (Table 5).

Generally, the variables analyzed reflected the population in that each group had the majority of the mothers using adequate prenatal care, then intermediate care, then no care (Table 4). The only three groups to differ from this were those with a prior preterm birth, African American mothers, and those who delivered preterm during the current pregnancy. Of the 644 women with a prior preterm birth, 1.22% of them had inadequate prenatal care, and only 0.76% had intermediate care. Of the 4,046 African American mothers, 0.83% had no care, which was more than the 0.26% that had intermediate care. Lastly, of the 1,620 mothers that delivered preterm, 1.86% had inadequate care compared to 1.26% who had intermediate care.

The mothers that most utilized adequate prenatal care were women with prenatal diabetes, married mothers, those with private insurance, and those with fathers who had more than a high school education (Table 5). One hundred percent of women with prenatal diabetes had adequate care, 99.35% of those with private insurance had adequate care, 99.34% of those whose father had more than a high school education had adequate care, and 99.26% of married women had adequate care.

The mothers that had the highest rates of inadequate prenatal care use were those with a prior preterm birth, smokers, African Americans, and those with current preterm delivery. Of the mothers who delivered preterm, 1.86% had inadequate care; of the mothers with a prior preterm birth, 1.22% had inadequate prenatal care; of the African American mothers, 0.83% of them

utilized inadequate prenatal care; and of the mothers who smoked, 0.81% of them utilized inadequate prenatal care (Table 5).

Of the variables with a significant association with preterm birth (prenatal diabetes, prior preterm birth, African American Race, unmarried mothers, mothers >35 years, mothers with <H.S. education, and fathers with H.S. education), the utilization of prenatal care was somewhat split, but more fell on the side of inadequate utilization of prenatal care (Table 5). As previously noted, women with prenatal diabetes utilized adequate care 100% of the time. In addition, those whose fathers had a high school education utilized adequate care 98.95% of the time and inadequate care 0.32% of the time. These are both above the median for adequate prenatal care (Table 5).

Conversely, 1.22% of mothers with a prior preterm birth had inadequate prenatal care, as did 0.83% of African American mothers, 0.6% of unmarried mothers, 0.58% of mothers over the age of 35, and 0.74% of mothers with less than a high school education (Table 4).

Table 5. Risk factors and their adequacy of prenatal care								
Risk Factors		**Kessner Index**						
		Adequate n=15,614		**Intermediate n=114**		**Inadequate n=61**		**Total**
		n	**%**	**n**	**%**	**n**	**%**	**n**
Term	**Preterm**	1,620	96.95	21	1.26	31	1.86	1,671
	Full Term	13,994	99.13	93	.66	30	.21	14,117
Pre Pregnancy Diabetes	**Yes**	151	100	0	0	0	0	151
	No	15,405	98.88	114	.73	60	.39	15,579
Gestational Diabetes	**Yes**	996	99.01	7	.67	3	.30	1,006
	No	14,560	98.89	107	.73	57	.39	14,724
Prior Preterm Birth	**Yes**	644	98.02	5	.76	8	1.22	657
	No	14,918	94.96	109	.72	52	.34	15,079
Race	**White**	11,130	99.11	73	.65	27	.24	11,230
	African American	4,046	98.28	37	.26	34	.83	4,117
	Other	438	99.01	4	.90	0	0	442
Marital Status	**Married**	8,204	99.26	45	.54	16	.19	8,265
	Not Married	7,410	98.48	69	.92	45	.60	7,524
Mother's Age (years)	**< 20**	1,865	98.47	20	1.06	9	.48	1,894
	20-35	12,553	98.98	85	.67	45	.35	12,683
	> 35	1,196	98.68	9	.74	7	.58	1,212
WIC status	**Yes**	6,587	98.68	61	.91	27	.31	6,675
	No	8,992	99.04	53	.58	34	.37	9,079
Smoking Status	**Smoker**	2,301	98.12	25	1.07	19	.81	2,345
	Non- Smoker	13,307	99.03	89	.66	42	.31	13,438
Method of Pay	**Medicaid**	6,361	98.45	62	.96	38	.59	6,461
	Private	7,663	99.35	38	.49	12	.16	7,713
	Other	1,438	98.43	13	.89	10	.68	1,461
Mother's Education	**< High School**	2,650	98.04	33	1.22	20	.74	2,703
	High School	4,021	98.70	33	.81	20	.49	4,074
	> High School	8,926	99.23	48	.53	21	.23	8,995
Father's Education	**< High School**	1,605	98.29	20	1.22	8	.49	1,633
	High School	4,044	98.95	30	.73	13	.32	4,087
	> High School	7,102	99.34	34	.48	13	.18	7,149
Percentages based on risk factor (n)/Total for specific risk factor								

Discussion

The data shows that mothers in Montgomery County who have a significant risk for preterm birth are those with less than a high school education, those where the father of the baby had only a high school education, mothers who were unmarried, mothers who had diabetes prior to being pregnant, mothers who had a prior preterm birth, mothers who were over the age of 35, and African American mothers. These are all consistent with the most updated preterm birth research (Dominguez et al., 2008; Newburn-Cook & Onyskiw, 2005; Nkansah-Amankra et al., 2010; Mercer et al., 1999; DeFranco et al., 2008; Rosenberg, Garbers, Lipkind, & Chiasson., 2005). In addition, the data demonstrates that mothers who did not adequately utilize prenatal care were more likely to have a preterm versus a full term infant. In fact, for mothers who delivered preterm, 1.86% of them had inadequate prenatal care, which was the highest prevalence for inadequate care.

Interestingly, the most likely to utilize prenatal care were those who had prenatal diabetes. It is likely that given their health history they had regular care by a physician and were made aware of the risk to pregnancy, making them more likely to utilize prenatal care. There is very little information regarding utilization of parental care specifically among women with pregestational diabetes mellitus to compare this finding. Therefore, this is a subject where further research would be warranted.

The other types of mothers who most utilized prenatal care were those mothers who had private insurance, those whose fathers had more than high school education, and mothers who were married. This is consistent as all of these groups were more likely to have higher education and high pay, which also is related to higher socioeconomic status (SES). Historically, those with higher SES tend to have better birth outcomes overall (Nkansah-Amankra et al., 2010).

The mothers who most utilized inadequate care were those with a prior preterm birth, African Americans, and smokers. It is surprising that those mothers with a prior preterm birth did not adequately utilize prenatal care given the risk it presents. However, it could be likely that the same reasons that they had a previous preterm birth are related to current underutilization of prenatal care. This would be a good topic for future research.

Of those mothers that were at increased risk for preterm birth, the ones who utilized adequate prenatal care the most were ones where the father of the baby had more than a high school education and those with prenatal diabetes. It is possible that although they had adequate care these groups contained risk factors that were more significant than the use of adequate prenatal care. Specifically, with prenatal diabetes, and its significant impact on the health of the mother, it is likely that this is a risk factor that outweighs the benefit of prenatal care (Rosenberg et al., 2005).

Of the mothers that were at increased risk for preterm birth, the ones who utilized inadequate care the most were mothers who were unmarried, African American, over the age of 35, and those with less than high school education. Those mothers are more likely to be of low socioeconomic status, which is associated with poor birth outcomes (Dominguez et al., 2008; Newburn-Cook & Onyskiw, 2005; Nkansah-Amankra et al., 2010; Mercer et al., 1999; DeFranco et al., 2008; Rosenberg et al., 2005). It is unclear why mothers who were over 35 did not utilize enough prenatal care. This would be an additional topic for further research. This study found some results that were not expected. First, that smoking in mothers did not significantly increase the risk of preterm birth, and secondly, that the use of WIC was not a risk factor.

Smoking was not a significant risk factor for preterm birth in this study. However, it is likely that this is related to how the mother's smoking status was defined in the research

(Smoking status was defined by a mother who smoked any cigarettes at any point in the pregnancy, including those who stopped during the first trimester). Research has shown that there may be a dose dependent relationship of smoking with birth outcomes. Specifically, Kolas, Nakling, and Salvesen found in 2000 that for multiparous women smoking during pregnancy increases the risk for preterm delivery, and in addition, there appeared to have been a dose-response effect of smoking (Kolas et al., 2000). Also, there is a timing relationship with smoking and pregnancy. Some research shows that if women stop smoking in the first trimester, the risk smoking has on preterm birth goes away (Mainous & Hueston, 1994). Our research included moms who smoked in the first trimester and could have influenced the results. Thus, our definition of smoking in this study may have diluted the risk.

Another finding that was unexpected was that WIC users did not show a significant risk for preterm birth. Due to the income requirement for eligibility for the program, they are a good representative of a lower socioeconomic status population. A possible reason for this is that although WIC participants are in a lower SES group, they also are utilizing a tool that's main purpose is to create healthier mothers and infants. Thus, the benefit the mothers obtained from utilizing WIC may have counteracted the risk of low SES. Bitler and Currie (2005) found that even though WIC participants are negatively selected on a wide array of observable risk factors, WIC participation is associated with improved birth outcomes, even when controlling for other factors.

Several study limitations deserve to be addressed. First, there are always limitations in the use of birth certificate data and its accuracy. Although it has improved in recent years, it is still based on medical records and therefore some of the information such as tobacco use as well as other categories are self-reported, which can be biased. In addition, the research did not

discriminate for Hispanic origin or for the race of the father. Therefore, it would be important for future research to focus on racial and ethnicity categories of the father and mother to see the associations with preterm birth.

Also, results showed that most people in the population had adequate care as defined by the Kessner Index and very few had inadequate care. This may potentially to be an overestimate of those with adequate care and an underestimate of those with inadequate care. As well as being a potentially inaccurate, it also makes the results more difficult to interpret.

Future research should focus on groups who are less likely to receive adequate prenatal care. Since the findings show that inadequate prenatal care is a significant risk factor for preterm birth, finding those populations that are not utilizing it properly may help to reduce incidence of preterm birth. In addition, these results do help to answer "who" but further research on "why", as in why a specific population is not utilizing adequate prenatal care may be the next step in helping to prevent preterm birth.

Conclusion

The results were generally consistent with the consensus of the research on preterm birth in that adequate prenatal care was related to a decrease in preterm birth. Also, prior preterm birth was the highest indicator of a recurrent preterm birth. However, there are areas that could be expanded upon or changed in future research including assessing smoking status more specifically by trimester, more specifically defining race by father's and mother's race as well as indicating Hispanic ethnicity, and looking at multiple prenatal care indexes to potentially address different ways of analyzing prenatal care.

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Appendix 1 – Kessner Index

Kessner Index **Adequacy of Prenatal Care defined in terms of timing and quantity of prenatal visits, adjusted for gestation length**		
Adequacy of Prenatal Care	**Gestation (weeks)**	**Number of prenatal visits**
Adequate[a]	13 or less than and	1 or more or not stated
	14-17 And	2 or more
	18-21 And	3 or more
	22-25 And	4 or more
	26-29 And	5 or more
	30-31 And	6 or more
	32-33 And	7 or more
	34-35 And	8 or more
	36 or more And	9 or more
Inadequate[b]	14-21[c] And	0 or not stated
	22-29 And	1 or less or not stated
	30-31 And	2 or less or not stated
	32-33 And	3 or less or not stated
	34 or more And	4 or less or not stated
Intermediate *(combinations other than those specified above or those having no care)*		
No care *(Both the number of visits and month care began indicate no prenatal care visits)*		
[a]*In addition to the specific number of visits indicated for adequate care, the interval to the first prenatal visit had to be 13 weeks or less (first trimester)* [b]*In addition to the specific number of visits indicated for inadequate care, all Women who started their care during the third trimester (28 weeks or later) were considered to have inadequate care.* [c]*For this gestation group, care was considered inadequate if the time of the first visit was not stated.* [d]*When month and year are specified but day is missing, impute 15 for day.*		
Institute of Medicine, National Academy of Sciences: Infant Deaths, An Analysis by Maternal Risk and Health Care. In: Contrasts in Health Status, Vol. I, 1973. Based on: The American College of Obstetricians and Gynecologists: Standards for Obstetric-Gynecologic Services. Chicago, 1974. Internal modifications have been made to differentiate those having "no care" from those having "inadequate" or "intermediate" care.		

Appendix 2 – IRB Approval

Office of Research and Sponsored Programs
201J University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: December 15, 2010

TO: Leslie Schmieder, P.I., MPH Student
MPH
Sara Paton, Ph.D., Fac. Adv.
MPH

FROM: B. Laurel Elder, Chair
WSU Institutional Review Board

SUBJECT: SC# 4365
'A Look at Preterm Births and Prenatal Care in Montgomery County'

At the recommendation of the IRB Chair, your study referenced above has been recommended for exemption. Please note that any change in the protocol must be approved by the IRB; otherwise approval is terminated.

This action will be referred to the Full Institutional Review Board for ratification at their next scheduled meeting.

NOTE: This approval will automatically terminate two (2) years after the above date unless you submit a "continuing review" request (see http://www.wright.edu/rsp/IRB/CR_sc.doc) to RSP. You will not receive a notice from the IRB Office.

If you have any questions or require additional information, please call Robyn Wilks, IRB Coordinator at 775-4462.

Thank you!

Enclosure

RESEARCH INVOLVING HUMAN SUBJECTS

SC# 4365

ACTION OF THE WRIGHT STATE UNIVERSITY
EXPEDITED REVIEW
Assurance Number: FWA00002427

Title: 'A Look at Preterm Births and Prenatal Care in Montgomery County'

Principal Investigator: Leslie Schmieder, P.I., MPH Student
MPH
Sara Paton, Ph.D., Fac. Adv.
MPH

The Institutional Review Board Chair has approved an exemption with regard to the use of human subjects on this proposed project.

REMINDER: Federal regulations require prompt reporting to the IRB of any changes in research activity [changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), except where necessary to eliminate apparent immediate hazards to subjects] and prompt reporting of any serious or on-going problems, including unanticipated adverse reactions to biologicals, drugs, radioisotope labeled drugs or medical devices.

B Lamont Eller M.D.

Signed Chair, WSU-IRB
Approval Date: December 15, 2010
IRB Mtg. Date:

Appendix 3 – List of Public Health Competencies Met

Specific Competencies
Domain #1: Analytic Assessment Skill
Defines a problems
Determines appropriate uses and limitations of both quantitative and qualitative data
Selects and defines variables relevant to defined public health problems
Evaluates the integrity and comparability of data and identifies gaps in data sources
Applies ethical principles to the collection, maintenance, use, and dissemination of data and information
Partners with communities to attach meaning to collected quantitative and qualitative data
Makes relevant inferences from quantitative and qualitative data
Applies data collection processes, information technology applications, and computer systems storage/retrieval strategies
Recognizes how the data illuminates ethical, political, scientific, economic, and overall public health issues
Domain #2: Policy Development/Program Planning Skills
Utilizes current techniques in decision analysis and health planning
Domain #3: Communication Skills
Communicates effectively both in writing and orally, or in other ways
Solicits input from individuals and organizations
Advocates for public health programs and resources
Effectively presents accurate demographic, statistical, programmatic, and scientific information for professional and lay audiences
Attitudes
Listens to others in an unbiased manner, respects points of view of others, and promotes the expression of diverse opinions and perspectives
Domain #4: Cultural Competency Skills
Identifies the role of cultural, social, and behavioral factors in determining the delivery of public health services
Develops and adapts approaches to problems that take into account cultural differences
Attitudes
Domain #5: Community Dimensions of Practice Skills
Develops, implements, and evaluates a community public health assessment
Domain #6: Basic Public Health Sciences Skills
Identifies the individual's and organization's responsibilities within the context of the Essential Public Health Services and core functions
Defines, assesses, and understands the health status of populations, determinants of health and illness, factors contributing to health promotion and disease prevention, and factors influencing the use of health services
Understands the historical development, structure, and interaction of public health and health care systems
Identifies and applies basic research methods used in public health
Applies the basic public health sciences including behavioral and social sciences, biostatistics, epidemiology, environmental public health, and prevention of chronic and infectious diseases and injuries
Identifies and retrieves current relevant scientific evidence
Identifies the limitations of research and the importance of observations and interrelationships

Domain #6: Basic Public Health Sciences Skills
Attitudes
Develops a lifelong commitment to rigorous critical thinking
Domain #7: Financial Planning and Management Skills
Manages information systems for collection, retrieval, and use of data for decision-making
Domain #8: Leadership and Systems Thinking Skills
Identifies internal and external issues that may impact delivery of essential public health services (i.e. strategic planning)