Examining Maternal and Neonatal Health Outcomes:

The Influence of Substance Use, Late Entry to Care, and Amish Group Membership

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Introduction and Overview

For the past several years, incarceration rates in the United States have fallen for men, but increased for women (Penal Reform Briefing 2008). Contrary to public perception, much of this increase has been driven by incarceration in jails located in rural counties and small towns rather than large cities (Subramanian, Henrichson, Kang-Brown 2015). For example, the jail incarceration rate in Orange County, Indiana was recently reported as 314 per 100,000 in contrast to 207 per 100,000 in Marion County home to Indianapolis that state's largest city (Subramanian, Henrichson, Kang-Brown 2015). One of the main issues driving this increase is drug abuse and addiction (Carson 2015). The social consequences of drug addiction have been significant ranging from overcrowded jails and an overburdened foster care system to declining life expectancy for rural white women in some places such as West Virginia and Kentucky (Keller and Pearce 2016, Vera Institute of Justice 2015). It is not surprising that maternal and infant health are at risk given that women of child bearing age are the age group most likely to be drug users (Forray 2016). An additional challenge for Orange County may be the relatively sizeable Amish population who according to some researchers tend to only seek care when complications arise during failed home births (Deline 2012).

As part of Sustaining Hoosier Communities the College of Arts and Sciences Liberal Arts Management Program's Analytical Problem Solving students partnered with Dr. Yolanda Yoder and Southern Indiana Community Health Care to explore a number of questions related to maternal and infant health in Orange County[i]. First, we analyzed obstetrics data to determine the typical trimester that women enter into care and the smoking rate for pregnant women. In addition, we performed regression analysis to examine if substance abuse correlated with entry into care as it impacts Apgars, preterm deliveries, or other neonatal outcomes while controlling for other factors that may affect mother and infant health. Last, we evaluated whether there are sub-population differences between Amish, non-Amish, and mothers with positive drug screens across a variety of outcomes. Overall, our findings indicate that while most pregnant women enter into care during the first trimester, over 36 percent enter later. Moreover, around 5 percent did not receive care prior to giving birth and these women were almost exclusively Amish. While entering care later was associated with a greater likelihood of experiencing maternal, neonatal, and birth complications the impact was similar for Amish and non-Amish women. Even though women who tested positive for drugs on their initial drug screening did not tend to enter into care later than others, they did have significantly more problems especially on neonatal measures. Of particular concern though is the number of mothers who smoked throughout their pregnancies (35%).

Maternal Behaviors, Neonatal Outcomes, and Maternal Complications

Previous research indicated four overarching themes that pointed towards a relationship between maternal behavioral patterns and neonatal outcomes. These four themes are as follows: rural communities and drug usage, maternal alcohol consumption and neonatal complication, pregnancy risk factors and neonatal morbidity, maternal drug usage and neonatal complications. The first theme, rural communities and drug usage, encompassed studies that determined whether mothers from rural communities were more likely to use drugs while pregnant. In 2018, Baer et al., analyzed case-studies to examine factors influencing late entry into prenatal care. For the purposes of this study, late entry into care was defined as six months after gestation. The case studies were drawn from live births in California between 2007 and 2012, which included 3 million women. The variables the researchers focused on were maternal age, education, smoking, drug or alcohol abuse/dependence, mental illness, participation in the Women, Infants, and Children's program and rural resident. After a backwards regression analysis was conducted, the researchers concluded that women in rural communities were more likely to consume drugs while pregnant - which is a major factor towards their late entry into care (Baer et al., 2018).

The second theme, maternal alcohol consumption and neonatal complications focused on studies the neonatal birth problems that arise when mothers consume alcohol while pregnant. According to Hamulka et al., such behaviors increased the risk of a preterm birth, significantly lower infant's birth weights, and are associated with an Apgar score below 6. According to the article, an Apgar score is a measure of the baby's health on a score of 1 to 10. Scores of 7, 8, or 9 are normal and indicate that the newborn is in good health. Any score below 7 is indicative that the baby has many health problems that need to be addressed. The author writes that newborns from alcohol-consuming mothers suffer from respiratory problems, cardiac issues, and neurological deficits that warrant a low Apgar score (Hamulka et al., 2018).

The third theme describes how different pregnancy risk factors can affect neonatal morbidity. One study used different risk factors/exposures, such as smoking at any time during pregnancy or drug dependency, and their effect on three different variables that were measures of early neonatal morbidity: Apgar scores less than 7 measured 5 minutes after birth, NICU admission, and required resuscitation. The researchers found that smoking, daily or high alcohol consumption, and drug dependency during pregnancy were the three highest risk factors associated with the most significant negative effects on neonatal morbidity. This study also found that smoking was the main contributing factor that affected neonatal morbidity. These researches determined that by eliminating smoking, there could be a 10-15% reduction in all three of the early neonatal morbidity variables (Burstyn et al., 2010). Another study found that socioeconomic status was an important factor in determining nicotine addiction. This study determined that nicotine dependence was the most significant factor that influenced maternal smoking in pregnancy (Gilman et al., 2008). These two studies both suggest that eliminating smoking during pregnancy is of the utmost importance to help reduce neonatal morbidity.

The fourth and final theme explores the relationship between maternal drug usage and neonatal complications. One study found that mothers who were known drug users had higher rates of preterm births, experienced more placental abruptions, had babies with lower birth weights, and had children with more growth restrictions (Pinto et al., 2010). In another study, the researchers looked at the effects of smoking and birth weight and they found that mothers who smoked while pregnant had babies that had a mean weight lower than mothers who did not smoke during pregnancy (Kataoka et al., 2018). These two studies both suggest that pregnant, substance-abusing mothers have more neonatal complications than mothers who do not have substance abuse issues.

In addition to neonatal problems, smoking, drug, and alcohol use has been associated with a number of maternal complications such as septic thrombophlebitis, pre-eclampsia, eclampsia, and post-partum hemorrhage (Finnegan 2013). Moreover, tobacco use and alcohol may exacerbate pre-existing conditions issues such as high-blood pressure. However, drug use often coincides with other issues known to affect maternal health increasing the risk of complications for both the mother and her unborn child. For example, women with drug or alcohol dependency often have poorer nutrition because their lifestyles preclude healthy eating and their bodies are less efficient in processing nutrients (Sebastiani et al. 2018). Likewise, some studies have found that women who use drugs during pregnancy, particularly illicit drugs, are more likely to experience abusive relationships and stress that is associated with adverse health consequences (Parker,McFarlane, and Soeken 1994; Curry, Perrin, and Wall 1998; Finnegan 2013). Others have noted that women who use illicit drugs may fear criminal prosecution and therefore delay entry into care, which can increase the risk for both maternal and infant complications (Kampschmidt 2015). As the number and severity of complications increase, so too does the cost of medical care for both mother and child. Although cost-comparison studies are surprisingly limited, drug treatment programs even when residential come at a far lower price tag than birth complications and care in neonatal intensive care units (Svikis 1997).

As a group, the Amish, are generally viewed as a subculture that is sequestered from modern life, yet increasingly touched by the problems of the outside world. Over the last decade there has been a rising awareness of drug problems among the Amish across the heartland including Indiana, Ohio, and Pennsylvania (Weber, Cates, and Carey 2010). To date, knowledge of how drug use might impact maternal and infant health seems largely unstudied in Amish communities and the literature regarding use of obstetricians and medical care is mixed. Keesler (2011) reports that young pregnant Amish women typically enter into care during the first trimester just as their non-Amish counterparts do. However, the report also notes that as Amish women age and have more experience with pregnancy they seek care later and later in pregnancy (Keesler 2011). In contrast, other research suggests a strong preference for at home births free of technology suggesting that they will be unlikely to seek an obstetrician and hospital birth unless complications arise (Deline 2014).

Methods

Data

The data utilized in our analyses comes from medical chart records for 83 deliveries at Paoli Hospital during 2017. The data includes health information for both mothers and their babies. Women who deliver their babies at Paoli Hospital generally have received prenatal care from Southern Indiana Community Health Care. However, it is important to note that patients with the most serious risks are referred out to other doctors and hospitals and thus are not included in this dataset. The dataset does not include geographic information, but we assume that all were Orange County residents. Aside from age, other demographic variables related to social determinants of health were not included. The sample size is slightly inconsistent across different analysis because some data was missing on particular measures for some women. However, missing data analyses suggests that data was missing at random and did not compromise the analyses.

Measures

Below in Table 1 is a description of the variables we used in our analyses. With such a small sample analyzing some of the outcomes individually was not possible because they rarely occurred. On some outcomes only one infant was born with that particular problem. For this reason we created two scales for outcomes of interest. These are birth problems and maternal complications. While ideally all the individual outcomes would be analyzed independently, it is also important to know how many complications a baby is born with or a mother has during pregnancy. We have also include here frequency distributions for some of our key variables. We will briefly highlight some of what the descriptive statistics tell us. First, the age range for women in this sample was 16-39 with most falling in the middle as would be expected (Figure 1). While the majority of infants (n=69) did not have any birth problems nearly one-fourth (n=20) of the infants in the sample were born with at least one problem and nearly 5% (n=4) were born with three known problems (Figure 2). The types of problems infants had included neonatal abstinence syndrome, sepsis, cardiac issues, small for gestational age, premature, and a category included in the original data that was called other birth complications. Figures 3 and 4 present the frequency distributions related to positive drug screenings. Figure 3 depicts the results of the first drug screening. Most women did not test positive on their initial drug screening (n=62), but 18% or 14 women did test positive. We should note that the sample size declines to 76 because not all women were tested as some did not receive care before their delivery (Figure 3)[ii]. We also include in our analysis the total number of positive drug screenings under the assumption that more frequent users may deliver infants with more problems. As Figure 4 illustrates, we have few women who test positive for drugs more than once. Figure 5 shows that while the majority of women did not experience maternal complications, a fairly sizeable number did have at least one complication (n=24).

Table 1: Description of Variables

Variable	Description
Trimester_care	measures the trimester that the woman entered care whether this be with a midwife or obstetrician.
Birth_Problems	This variable is a count of the number of birth problems an infant had and includes neonatal abstinence syndrome, sepsis, cardiac issues, small for gestational age, premature, and a category included in the original data that was called other birth complications. Higher scores on this variable indicates that the infant has more birth problems. Each are weighted equally.
Cardiac	Indicates that the infant had a cardiac issue at birth
Apgar1	the wellbeing score given at 1 minute after birth, the maximum score is 10
Apgar2	the wellbeing score given at 5 minutes after birth, the maximum score is 10
Premature	Original data was incomplete, so this was calculated using gestational age. All births under 37 weeks gestation are coded as a "1" and all else are 0

Smoke	The mother smoked
Quit	Mother stopped smoking during pregnancy
Total_uds_pos	Total number of times mother tested positive for drugs during pregnancy
Uds1	Mother tested positive at initial drug screening
Placenta	Indicates if mother experienced placental abnormalities throughout pregnancy or during birth
Maternal_comp	Is a count of the number of complications a woman experienced during pregnancy and includes gestational diabetes, hypertension, and conditions coded in the original data as other complications. Each is weighted equally and higher scores indicate more complications.
Tri_ob	Indicates which trimester a woman entered care with an obstetrician
Tri_mw	Indicates which trimester a woman entered care with a midwife
Tri_no	Indicates that the woman did not report care with any type of provider
Late_entry	This variable indicates that a woman entered care in the third trimester or not at all
Amish	This is a dichotomous variable that indicates if the women is Amish
Patient_age	age of mother at time of birth

Figure 1: Age distribtuion of mothers

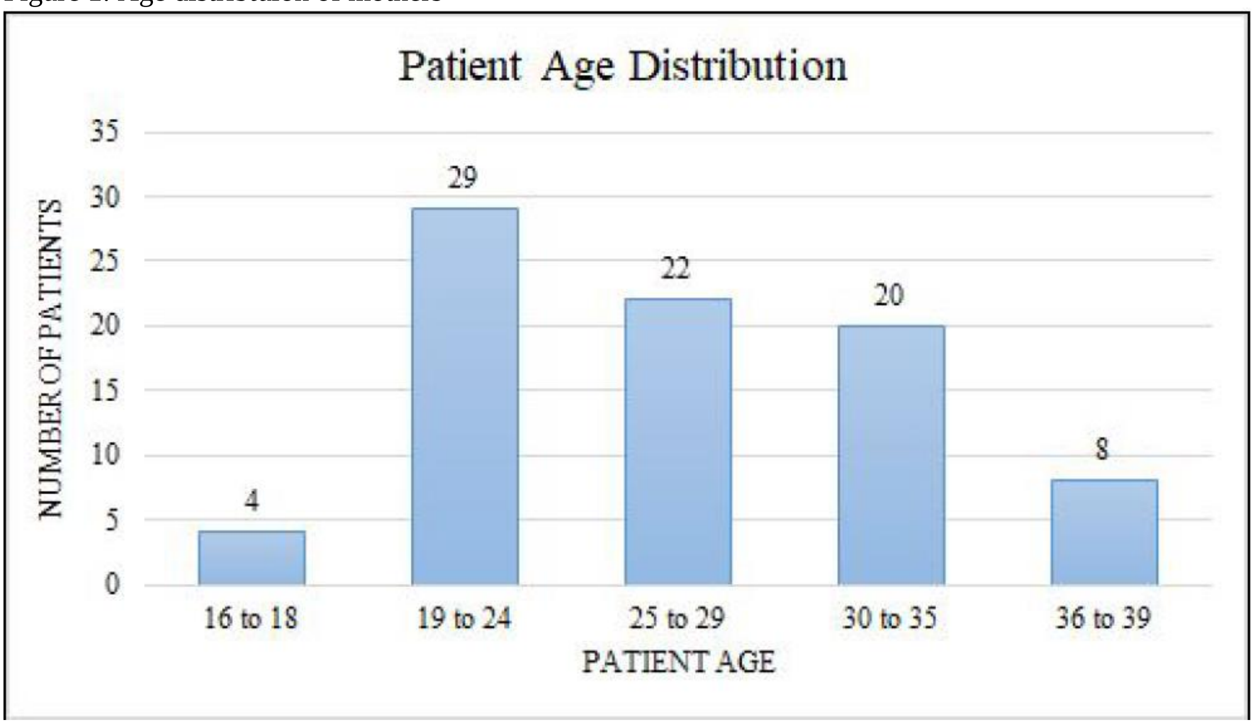


Figure 2: Distribution of total number of birth problems

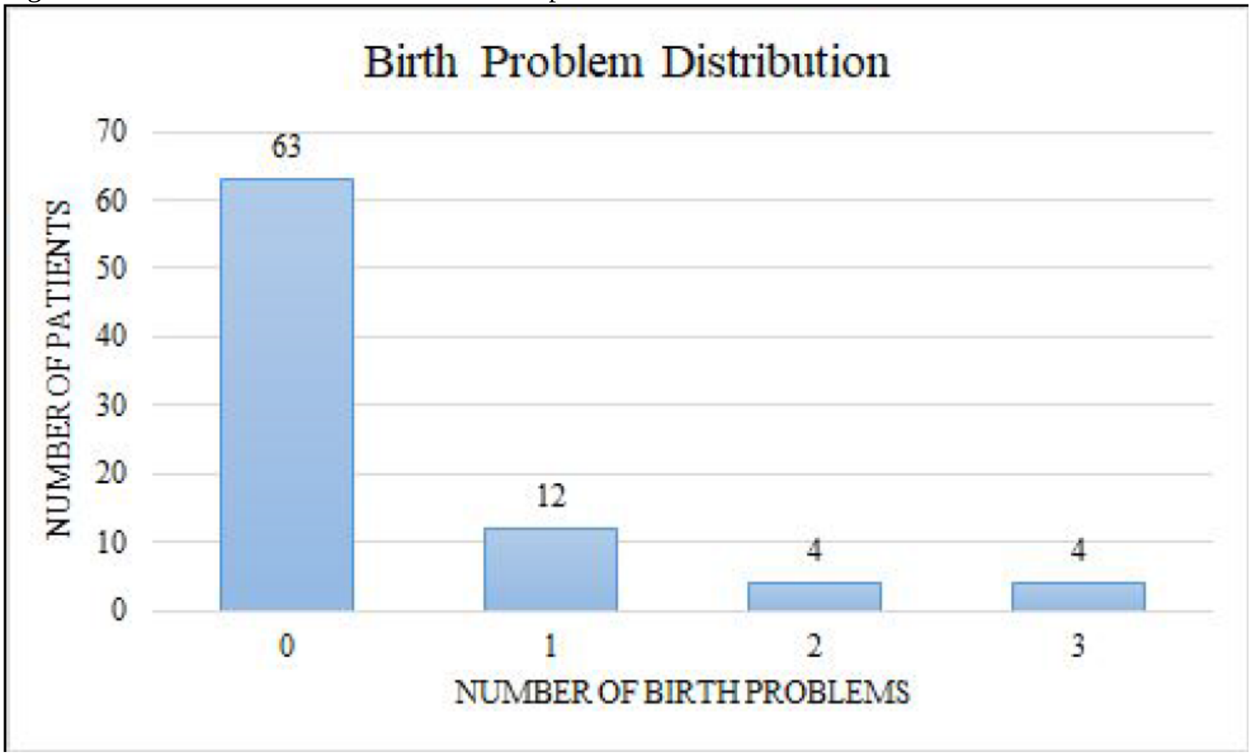


Figure 3: Distribution of initial drug screenings

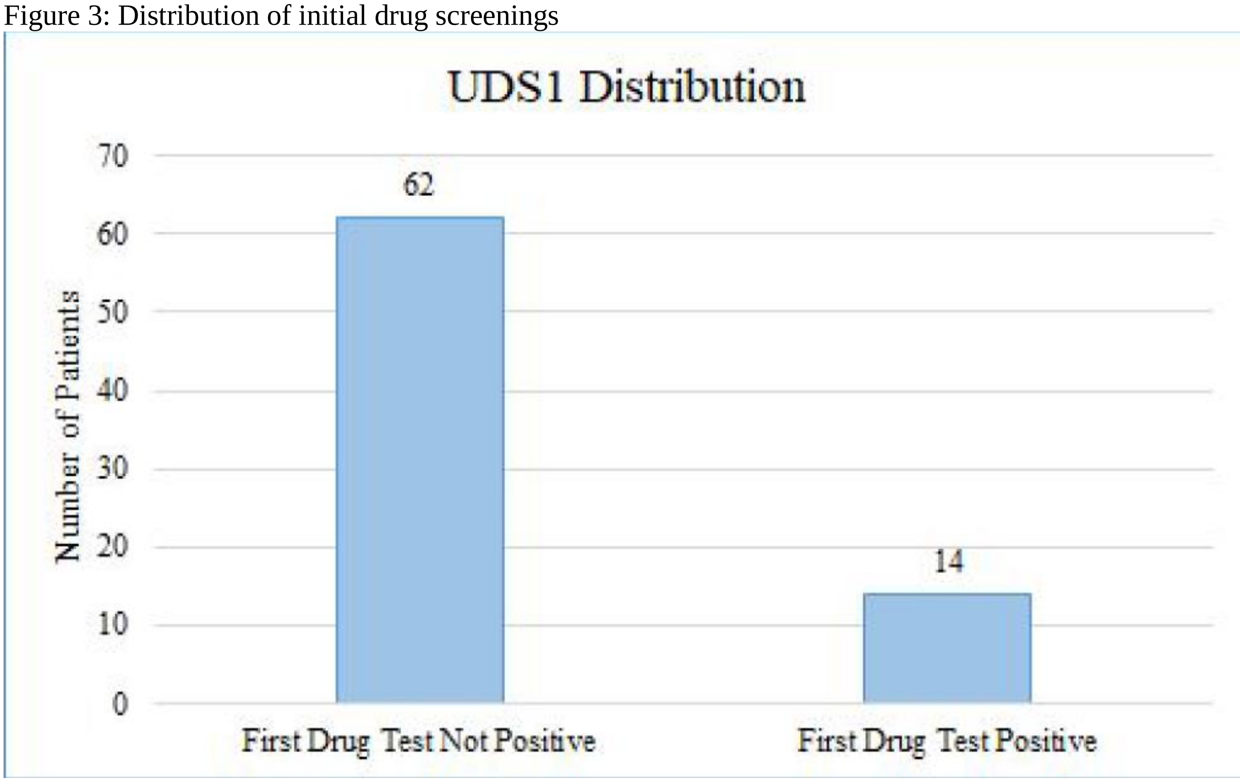


Figure 4: Total number of positive drug screenings

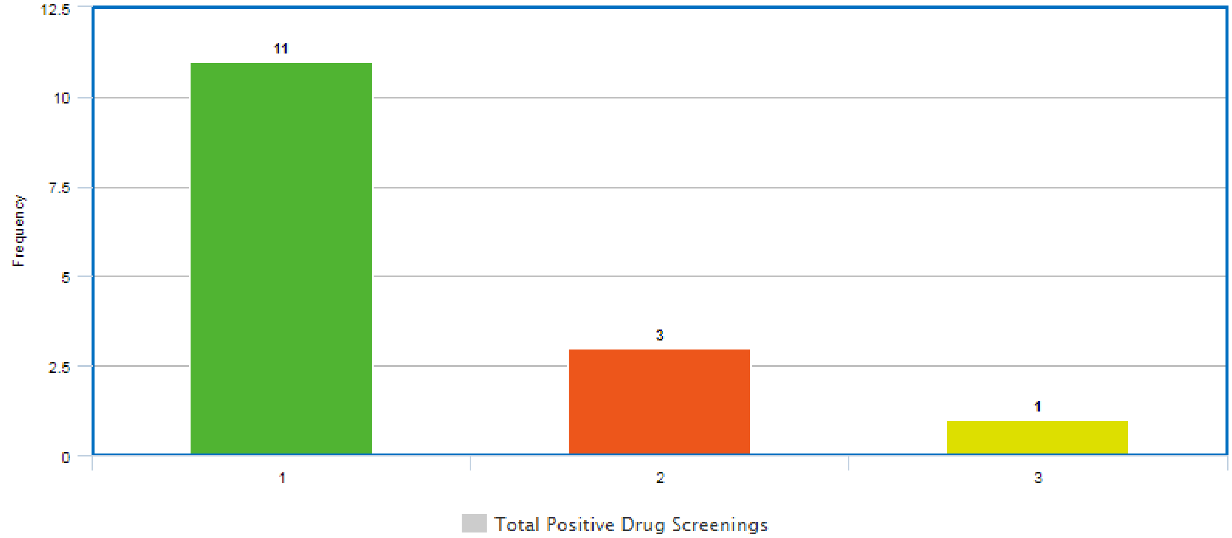
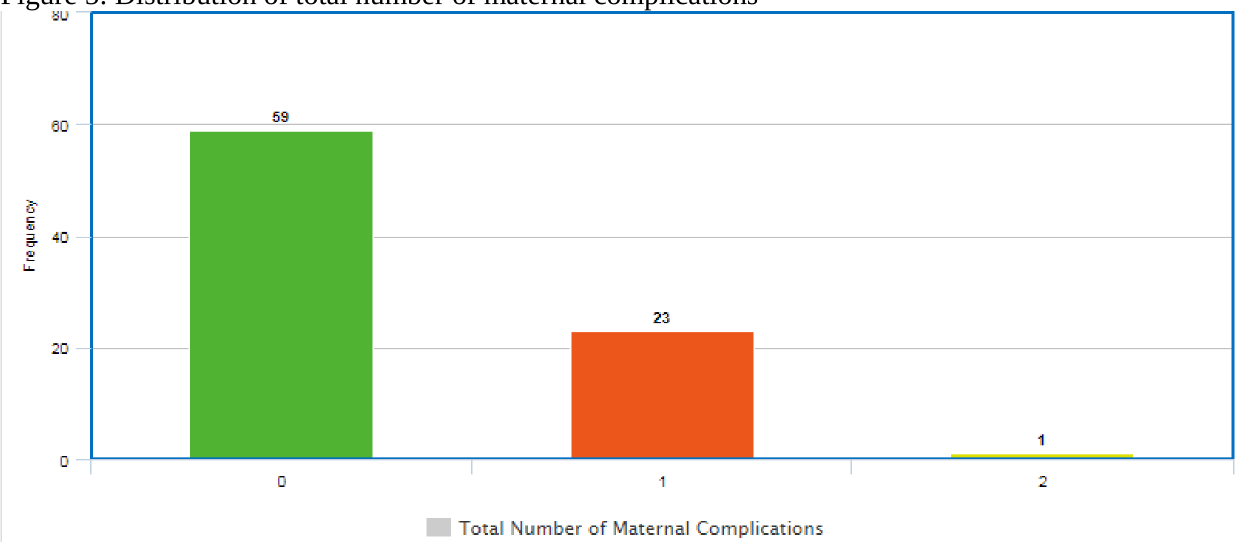


Figure 5: Distribution of total number of maternal complications



Analytic Strategy

We address a number of different types of questions and therefore use a variety of techniques. Some questions can be addressed by looking at descriptive statistics as we do for describing the typical trimester women entered care and smoking rate. In analyzing how substance abuse correlated with entry into care and neonatal outcomes we used correlation analysis as a first step. We also ran regressions to look at these relationships while controlling for other important variables. To analyze subpopulation differences we used t-tests to determine whether the means of our outcomes of interest were significantly different between groups such as between Amish and non-Amish women.

Results

The first question we address concerns entry into care. As is indicated below in Figure 6 most women (n=49) enter care during the first trimester. However, around 36 percent (n=30) entered later and some did not report care prior to birth most of who were Amish and experienced failed home births. Most of the literature defined late entry into care as entering care at 6 months or later. In this sample, around 12 percent would be defined as entering late based on this definition. We also examined the typical trimester that women enter care with an obstetrician compared to a midwife and report the results in Figures 7 and 8. Women who enter care with a physician usually do so in the first trimester, but the opposite is true for those seeing midwifes. The latter are far more likely to enter care in the second or third trimester.

Figure 6: Frequency Distribution for Trimester Entering Care

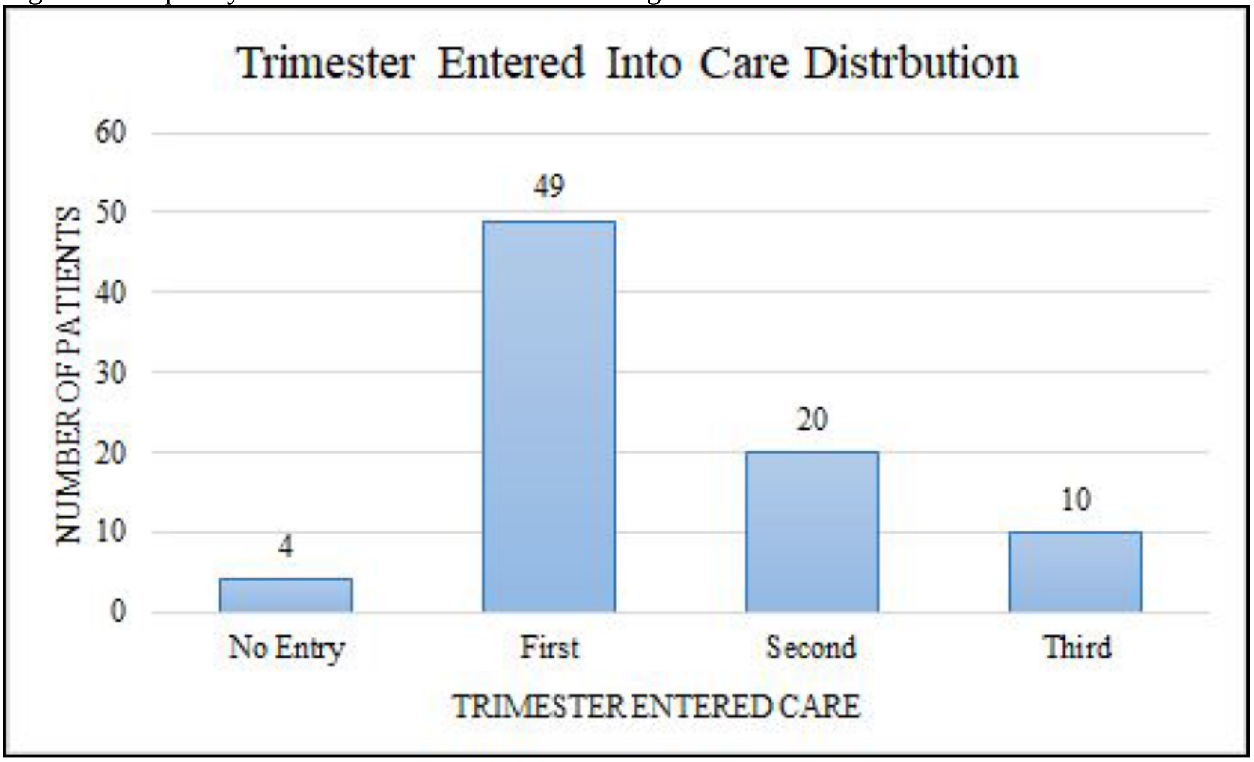


Figure 7: Graphical Illustration of Typical Trimester Entering Care with Obstetrician

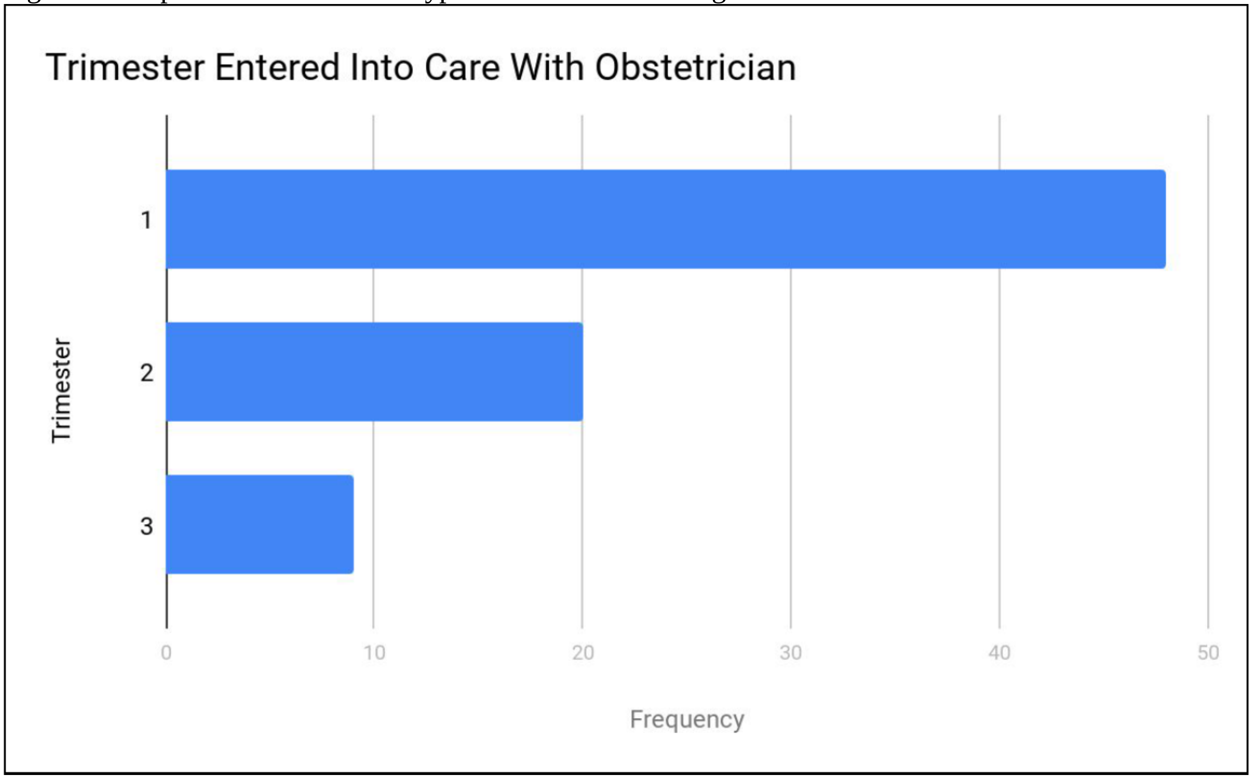
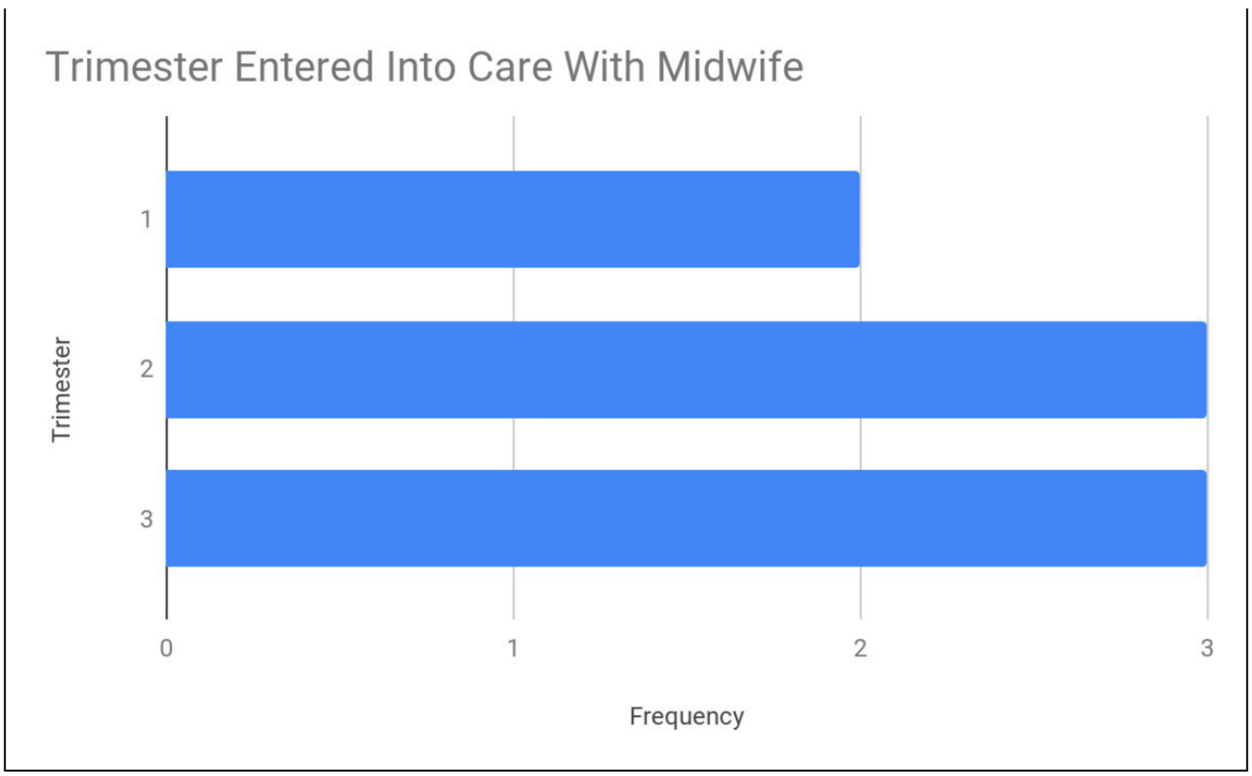


Figure 8: Graphical Illustration of Typical Trimester Entering Care with Midwife



The next question we addressed was the rate of smoking among pregnant women. To calculate the smoking rate in mothers, we simply looked at the variables “smoke” and “quit”. Smoke (N = 37) contained the raw number of mothers who smoked before pregnancy and quit (N = 12) had the number of mothers who quit because of the pregnancy. By subtracting the number of individuals who quit from the raw number of smokers, we were able to get a total of 25/72 mothers or a smoking rate of **35%**. This is much higher than the national and state smoking rates for pregnant women reported by the CDC, which are 7.2% and of 13.5% respectively[iii].

Before proceeding into multiple regression we conducted a correlation analysis to examine the relationship between the trimester mothers entered care, substance abuse, and select outcome variables. Table 2 presents our results. We first examined the relationship between entry into care and premature deliveries. We found that entry into care correlates with premature deliveries at the 90 % confidence level (r = -.20, p = .07). This correlation implies that as mothers enter into care later, they become more likely to have premature births.

Secondly, we looked for a correlation between entry into care and APGAR score. We used Apgar1 as our variable as this variable was commonly used elsewhere in the literature. We found no significant correlation between these variables (r = -.02, p = .88). In other words, the data does not provide evidence that Apgar scores reliably change based on when the mother entered into care.

After completing these measures of entry into care, we looked for correlations between the number of positive drug screenings and negative birth outcomes. First, we checked for a correlation between positive drug screenings and premature deliveries, and we found no significant correlation (r = -.02, p = .92). We also checked for positive drug screenings and Apgar scores and again found nothing of significance (r = -.05, p = .84). Finally, we checked for a correlation between the screenings and complications at birth and once more failed to reach significance (r = .10, p = .68)[iv].

Table 2: Correlations

Variables	Correlation	Significance (p-value)
Trimester_care premature	-0.1981	0.0726
Trimester_care apgar1	-0.0168	0.8807
Trimester_care complication	-0.1290	0.2453
Total_uds_pos premature	-0.0238	0.9230
Total_uds_pos apgar1	-0.0503	0.8381
Total_uds_pos complication	0.1021	0.6776

One possibility for the unanticipated results of the correlation between the number of positive drug tests and neonatal outcomes is that few babies had these problems, that very few mothers tested positive multiple times, or that those who did test positive on multiple occasions were using drugs that did not have as severe immediately recognizable consequences as one might expect. While we cannot address all of these possibilities, our next analysis attempts to provide some explanation. The regression analysis presented in Table 3 examined the relationship between testing positive for drugs during the initial screening and the number of birth problems present at birth while controlling for several other variables.

Table 3: Regression analysis for Birth Problems, Positive First Drug Screening

Birthprob	***B***	**Std. Error**	**t**	**P > |t|**
Amish	0.1780516	0.3367345	0.53	0.599
Patient_age	-0.0219475	0.0158629	-1.38	0.171
uds1	0.475509	0.2358517	2.02	0.048
Trimester	-0.2459476	0.1304347	-1.89	0.062

The regression analysis seen in Table 3 indicated that the relationship between uds1 and birthprob was statistically significant at a 95% confidence level (p=0.048). This means that, based upon this data set, there is a relationship between substance use and increased occurrence of birth problems even after controlling for other variables such as Amish group membership, patient_age, and the trimester the mother entered into care. This analysis also revealed a statistically significant relationship between trimester_care and birth problems at a 90% confidence level (p=0.062), meaning that when controlling for the variables Amish, patient_age, and uds1, later entry into care was correlated with a higher occurrence of birth problems. Although not statistically significant, the regression analysis in Table 3 revealed an interesting trend between patient_age and birthprob in which the older the mothers were, the fewer birth problems they had. This goes against what is commonly expected, which is that pregnancies of older women are at higher risk of complications. However, we speculate that this trend is relatively specific to this sample and is representative of how older women use fewer drugs and thus, the number of birth problems decreases.

We also conducted several t-tests to compare subpopulations across different outcomes. The results of a comparison of Amish and non-Amish women with placental abnormalities is presented in Table 4.

Table 4: Two-sample t-test comparing Amish and non-Amish mothers and placental abnormalities

Sample	# in Sample	Mean	Std. Error
Non-Amish	75	0.533333	0.0261205
Amish	8	0.5	0.1889822
Total	83	0.0963855	0.0325905
Difference		-0.4467	0.0994112
		P-value (at 95%)	0.0000

The p-value in the t-test for Amish and placental abnormalities (p=0.0000) indicates that the occurrence of placental abnormalities does depend on whether the mother is Amish or not. However, the small sample size (8 Amish women) should be considered before saying that Amish women are at a higher risk of placental abnormalities. A possible explanation for this data would be that the Amish women entered into care specifically because of the placental abnormality. Although not reported in a table here we also conducted a t-test for differences in the mean number of birth problems comparing Amish and non-Amish mothers. Results indicated that differences between the two groups in the mean number of birth problems was not statistically significant (p=.3318).

Next we tested subpopulation differences comparing women who tested positive on their initial drug screening with those who did not. The means of these two groups were significantly for birth problems and infant cardiac complications. For substance use and birth problems, the p-value in Table 5(p=0.0181) further verifies the relationship between substance use and increased birth problems as was seen in the regression analysis (Table 3). In regards to specific birth problems, such as cardiac complications, a similar relationship was also found in which substance using mothers had more children with cardiac complications than did substance free mothers (Table 6, p=0.0279).

Table 5: Two-sample t-test comparing mothers testing positive on initial drug screening and those who did not by birth problems

Sample	# in Sample	Mean	Std. Error
No birth problem	62	0.2903226	0.087225
Birth problem	14	0.8571429	0.3119796
Total	76	0.3947368	0.0938063
Difference		-0.56682013	0.2345329
		P-value (at 95%)	0.0181*

Table 6: Two sample t-test comparing mothers testing positive on initial drug screening and those who did not by infant cardiac complications at birth

Sample	# in Sample	Mean	Standard Error
No Cardiac Complication	62	0.016129	0.016129
Cardiac Complication	14	0.1428571	0.0970523
Total	76	0.0394737	0.0224842
Difference		-0.1267281	0.0565021
P-value (at 95%)		0.0279*	

Our next set of analyses concerns maternal health and late entry into care. We first conducted a t-test to determine whether there was difference in the mean number of maternal complications for those who entered care late or not at all and those who entered care in the first trimester and our results are in Table 7. The mean number of maternal complications for those who entered late or not at all was .50 while the mean for those who entered during the first trimester was .26. The t-test indicated that this difference was significant at the 95% confidence level(p=0.04) and we can conclude that women who enter care late or not at all do have a greater number of maternal complications.

Table 7: Two sample t-test comparing mean number of maternal complications by late entry into care

Sample	# in Sample	Mean	Standard Error
Did not enter care late	69	.5	0.1738384
Late entry	14	0.2608696	0.0532498
Total	83	0.3012048	0.0534855
Difference		0.2391304	.01412333
P-value (at 95%)		0.0471*	

While Amish women were significantly more likely to have placental abnormalities they were not necessarily more likely to have other complications or a greater number of maternal complications. Our results presented in Table 8 show that the mean number of maternal complications for Amish women was .50 and the mean number of complications for non-Amish women was .28, however this difference was not statistically significant (p=0.23).

Table 8: Two sample t-test comparing mean number of maternal complications for Amish and non-Amish women

Sample	# in Sample	Mean	Standard Error
Non- Amish	75	0.28	0.0555399
Amish	8	0.5	0.1889822
Total	83	0.3012048	0.0534855
Difference		-0. -.22	0.1807028
P-value (at 95%)		0.2270	

Our last analysis compared the mean number of maternal complications for women who tested positive on their initial drug screening and those who did not. The mean number of maternal complications for mothers who tested positive was .14 and for those who tested negative was

0.34. This alone suggests that the women who test positive have fewer complications, which is most certainly not what we would expect. However our analysis reveals that this is not statistically significant and in fact very likely occurred merely by chance (p=0.91). It is far more likely that women who use drugs especially on a regular basis do have greater maternal complications, we are just unable to capture that with this sample.

Table 9: Two sample t-test comparing mothers with positive initial drug screenings and those without based on maternal complications

Sample	**# in Sample**	**Mean**	**Standard Error**
Not positive	62	.0.14	0.0648129
Positive	14	0.34	0. 0970523
Total	76	0.3026316	0.0562567
Difference		.1958525	0. .1443127
P-value (at 95%)		0.9106	

As a supplement we ran an analysis comparing the number of maternal complications for those with more than one positive drug to those who tested positive only once, but again the results were not statistically significant likely because of the small number of women who tested positive more than once (p=0.47). Our last analysis compared women who tested positive for drug use more than once with those who did not test positive on the first screening. While the difference in the mean number of birth complications was still not statistically significant, it was much closer (p=0.14). Using some boostrapping techniques to enable us to "sample" our sample thereby creating an artificial dataset suggests that a larger dataset with more women who test positive more than once would lead to statistically significant results. It might also be possible to use propensity score matching, but this is an advanced technique far beyond the scope and time constraints of a statistics undergraduate course.

Discussion and conclusion

These analyses were conducted in an attempt to provide some insight into how drug use, the timing of entry into care, and being Amish might shape neonatal outcomes and maternal complications. This is especially important given the increased drug use and incarceration among women of child bearing age in rural places such as Orange County. On the one hand some of our analyses were complicated by our small dataset and the low frequency at which some complications occurred, however, on the other hand our findings were overall consistent with literature.

Compared to national data collected by the National Survey on Drug Use and Health, which included both women in urban and rural areas, women in the Orange County sample were more likely to use drugs. In fact they were about twice as likely to test positive during the first trimester as women in the national sample. However, based on the total number of positive drug screenings it seems that most women in this sample stop using, which is consistent with the national sample. Unlike, some of the previous research we did not find that drug using pregnant women to delay enter into care late (see Endnotes). That said, later than first trimester entry into care was an issue with around 36 of the 83 women not receiving care until at least the second trimester.

Even though testing positive for drugs was not a good predictor of late entry into care, it was an important predictor for negative neonatal outcomes and the number of problems an infant was born with. An initial first screening that was positive was statistically significant for predicting birth problems even after we controlled for Amish women who often delivered at the hospital due to a failed home birth, mother's age, and late entry into care. This is consistent with the literature. While it was surprising that the total number of positive drug screenings was not correlated with premature birth, Apgar scores, or the number of birth problems perhaps what we are seeing is that timing matters and the first trimester is critical for how some drugs impact the infant. In the future it might be useful to pool years so that analyses on the impact of different drugs at different points could be analyzed. It is also possible that there is some type of interactive effect with a variable we are not measuring. Some prior research suggests that women who use drugs while pregnant may have many other risk factors such as stress and an abusive environment. We are not measuring that here, but perhaps in the future such variables could be included. However, the bottom line remains that drug use generally has negative effects on neonatal outcomes.

Late entry into care had a negative impact on neonatal outcomes and maternal complications independent of positive drug screenings. While placental abnormalities accounted for most of the maternal complications with Amish women other women who entered care late were also at risk. Moreover, late care also puts infants at risk as can be seen with positive correlation between late entry and the number of birth problems infants have.

The findings here raise a number of issues. First, the typical entry into care for those who see an obstetrician is the mirror opposite of those who see a midwife or other lay provider. Those who see an obstetrician typically see a provider in the first trimester, but it is much later for those seeing other providers. This suggests that perhaps work like that done in Wisconsin where a culturally sensitive birthing center has been established for Amish women might be important. However, it is important to note that not all of the women delaying entry to care were Amish. Without demographic data it is difficult to theorize about the explanation. It is possible that education and social class play a role as women may be unaware of the Medicaid presumptive eligibility status pregnant women have in Indiana. There also could be accessibility issues for women living the greatest distance from providers. We encourage further analysis using geographic data. There are some other limitations that could also be addressed in subsequent analyses. In this data drug screening at birth for mothers and infants was almost entirely missing. Given the nature of the questions addressed, this data would be incredibly useful and we suspect potential grant funders would expect to see it. Nonetheless, the analyses presented here has laid the groundwork for additional work that is likely to be revealing on many fronts.

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[i] Although we were also asked to evaluate if late entry into care correlated with particular townships or zip codes, we did not have any data files that provided geographic information or any other demographic information on which to base such an analysis.

[ii] Drugs screenings included analysis for THC, cannabinoids, opiates (Rx or illicit), and methamphetamine. We were not able to analyze birth drug screenings because the data was almost entirely missing.

[iii] We chose not to pursue an analysis regarding smoking because much to our surprise there was no correlation between smoking and neonatal outcomes including the well-established low birthweight. This flies against such a vast amount of scientific research that we believe it to be an artifact of the data.

[iv] Supplemental correlation analyses were ran to examine the relationship between substance use and late entry into care. Neither testing positive for drug use during the initial screening or multiple times was related to late entry into care in this sample.