Maternal Health and Natality: A Snapshot of Factors Contributing to Newborn Weight

From fertility levels to social trends, patterns surrounding childbearing provide a glance at the future. A point of interest for many researchers in various fields, natality data becomes a tool to investigate trends, demographics, and understand patterns surrounding childbearing. The National Bureau of Economic Research data on natality, documenting measures from birth rate to maternal risk factors between the years 1968 to 2021, supports the examination of such inquiries. Our team decided to look specifically at natality data during the year 2019, choosing to exclude more recent years of 2020-2021 in case of confounding COVID factors, seeking to understand the impact of maternal health on newborn weight.

While the National Bureau of Economic Research's data on natality has some disadvantages, like collecting information via birth certificates which excludes the portion of children born to undocumented individuals, the data still provides a great platform for birth weight in relation to trends in natality to be discovered. Focusing on various health factors, this project investigates if there is a significant relationship between birth weight and the health of the mother, aiming to uncover insights on the impact of prenatal health care on newborn weight in order to provide a platform to increase awareness about the health of the mother during pregnancy.

Our data for 2019, contains information for over 3.75 million observations of mothers and their subsequent newborns. The first act when approaching these data was to narrow down our variables of interest, going from 130 to 10 variables: including age of the mother, cigarette use during pregnancy, BMI, weight gain during pregnancy, gestational diabetes, gestational hypertension, hypertension eclampsia, how many prenatal visits the mother made during pregnancy, infertility use, and the sex of the baby. After removing any missing or unreported data, we still retained over 3.5 million rows of data.

We chose to construct subgroups for the age of the mother, where we classified those who gave birth under 19 as teens, those between 20-24 as young, 25-34 years of age being medium, and over 35 as old. Part of the motivation to create these subgroups was to see for each age group, does the birth weight of the child show a significant difference, as it is known that women having children later in life have some risks for both the mother and child.

To conduct our analysis, ideally, we would create a randomized control trial where women would be randomly assigned to two groups receiving different healthcare approaches. This would allow for a controlled comparison of outcomes between groups to help isolate the specific effects of prenatal health care on maternal and child health. Although, this does propose some ethical issues as it could potentially put the child and mother at risk, and instead, we turned to regression to visualize predicted trends. Specifically, OLS models were used to estimate and understand baby weight in relation to various health factors. We understand that OLS is sensitive to outliers which could be a drawback, but it still is an unbiased estimator, and we proceeded with our analysis.

We approached our model by first examining the age of the mother, sex of the baby, and cigarette usage during pregnancy. The analysis of such features in comparison to the baby weight provided interesting insights, as we found all resulted in significant p-values under an alpha of 0.05, signifying that the baby's weight is indeed dependent on those variables. For example, our results indicate the average baby weight for a middle-aged mother is 3294 grams. This weight is reduced by 132 grams for teen mothers, 66 grams for young mothers, and 18 grams for old mothers. The variability of average baby weight across different age groups is minuscule but still present. At the same time, if a mother is a smoker the baby weight drops almost by 193 grams within the mother’s age category and sex of the baby.

Once we established these findings surrounding certain habits of the mother, we dove deeper into how the mother’s ailments impact the weight of the baby. For the mother’s ailments, we investigated whether a mother is diabetic, suffers from hypertension, and is prone to

eclampsia. Among these three the eclampsia factor is most dominant, which can be seen in Figure 1, with the baby experiencing a reduction of 446 grams if the mother has this health issue. Eclampsia is followed by hypertension with 245 gram reduction and then diabetes with a 20 gram increase in weight, respectively. The seemingly positive association with diabetes and baby weight intrigued us, and we proceeded to evaluate this finding by running a regression model with an interactive term for the mother's weight gain and the diabetes flag.

OLS Regression Results

Dep. Variable:	dbwt	R-squared:	0.016
Model:	OLS	Adj. R-squared:	0.016
Method:	Least Squares	F-statistic:	1.903e+04
Date:	Wed, 29 Nov 2023	Prob (F-statistic):	0.00
Time:	19:25:12	Log-Likelihood:	-2.7336e+07
No. Observations:	3536176	AIC:	5.467e+07
Df Residuals:	3536172	BIC:	5.467e+07
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	3291.2163	0.314	1.05e+04	0.000	3290.600	3291.833
rf_gdiab_Y	20.4737	1.153	17.752	0.000	18.213	22.734
rf_ghype_Y	-245.2919	1.095	-223.942	0.000	-247.439	-243.145
rf_ehype_Y	-446.4073	5.594	-79.801	0.000	-457.371	-435.443

Omnibus:	259792.210	Durbin-Watson:	1.913
Prob(Omnibus):	0.000	Jarque-Bera (JB):	517579.756
Skew:	-0.509	Prob(JB):	0.00
Kurtosis:	4.573	Cond. No.	19.2

Figure 1: Regression Model for Gestational Diabetic, Hypertension, and Eclampsia

The interactive variable had the intention to verify if diabetic mothers' weight gain leads to a greater increase in baby weight. Our analysis shows that for diabetic mothers, for each pound gained during pregnancy, the baby weight increases 1.6 grams less than that of non-diabetic mothers. We proceeded to check if diabetic mothers, in general, gain more weight than non-diabetic mothers by changing our dependent variable to weight gained by mothers and the independent variable to the diabetic dummy variable. The results indicated that diabetic mothers gain 4.7 pounds less than non-diabetic ones, implying we can strongly attest that statistically, there is no severe impact on baby weight if a mother is diabetic.

This could potentially be due to the fact that mothers who are diabetic may receive more health treatment in general, as the mother would need to carefully control her diabetes during

pregnancy - thus being able to catch any health issue related to her baby throughout the pregnancy. This would be an interesting topic for further research in the future.

Beyond this, infertility treatment and the number of prenatal care visits occurring during the pregnancy were our final points of interest in relation to baby weight. As it is observed that the babies conceived through IVF tend to be weaker, we ran a model for baby weight with the infertility column as an independent variable and found that the average baby weight of mothers treated for infertility is 150 grams less than that of the other babies. On top of this, by using Healthline's healthy baby weight classification of being between 2500-4500 grams, we found that as the number of prenatal care visits increases, it appears the weights converge towards a point within the healthy baby range. This is supported by our regression model, where we see that each extra visit for prenatal care leads to an increase in the baby weight by 3.6 grams.

Overall, taking a holistic view of all of our models, we note that while all variations in the weight of a newborn cannot be explained by our models, we are still able to draw important conclusions regarding the relationship between the mother's health and newborn weight. Eclampsia and hypertension treatment are needed greatly, as these largely play a role in the weight of the baby. This, along with more prenatal visits converging towards a common weight, showcases that all mothers deserve to have care regardless of their age. Perhaps in the future, more investigation could be done regarding the demographics of the mother to further uncover at-risk populations and lay the foundation for establishing more targeted interventions. Thus, while it is intuitive to understand that no smoking and the absence of certain ailments in general would most likely lead to a more healthy baby, it is still imperative to recognize that with insights from data, we can evaluate systematic approaches to maternal health to provide direction for future healthcare improvement.