PSTAT220A Project1

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The Effect of Prenatal Smoking and Mother's Age on Gestational Age, Infant Deaths, and Premature Births

1 Summary

Maternal smoking during pregnancy and mother's age are established risk factors for premature birth and sudden unexpected infant death. However, there is an on-going debate about the extent to which these associations are causal. It is difficult to determine whether these poor health outcomes are the result of prenatal smoking or are also attributable to characteristics of the mother which are correlated with prenatal smoking. The aim of this study is to compare pregnancy outcomes among smoking and non-smoking young and older pregnant women. The data included information on 6851 (654 (9.5%) smokers and 6197 (90.4%) non-smokers) pregnant women, of which 4915 (72%) are young mothers and 1936 (28%) are older mothers.Using chi-square tests to tease out the statistical differences and binary logistic regression analysis to examine the correlation between mother's age and smoking, and gestational age and survival of babies, I find that mother's age affects survival of babies and gestational age. Also the results indicate that mother's smoking habit affects survival of babies and gestational age however, contrary to what previous studies suggest, the effect is not statistically significant.

2 Introduction

Smoking during pregnancy and mother's age are known to negatively affect pregnancy outcomes and these two factors have been associated with numerous complications during pregnancy (Anderson et al., 2019; Lammimpää et al., 2013; Phowira et al., 2020). The aim of this study is to compare pregnancy outcomes among smoking and non-smoking pregnant women aged < 35 years and ≥ 35 [1] years.

In the data (N=6851), there are 654 women who were smoking during pregnancy, of whom 514 are classified as young and 140 are classified as older.

Statistical differences are evaluated using chi-square tests for dichotomous variables. All variables used in the binary logistic regression analysis were dichotomous with no missing data.

[1]The data we have does not specify the mother's age, just says "young" and "older". I took the liberty to interpret what "young" and "older" means in our data set. "Young" means that a mother is younger than 35 years old and "older" means that a mother is 35 years old or older.

Mother's age	smoker	Premature died in 1st year	Premature alive at 1st year	Full term died in 1st year	Full term alive at 1st year
Young	no	50	315	24	4012
Young	yes	9	40	6	459
Older	no	41	147	14	1594
Older	yes	4	11	1	124

Table 1: Cross-classification of infants by their survival and gestational age, and their mother's age and smoking habits.

3 Results

Using the chi-squared Independence test, I find that there is a significant relationship between mother's age and their smoking habits. Young mothers are more likely to smoke which confirms the finding of Lamminpää et al.'s study (2013). However, even though it does not confirm the argument that smokers are more likely to have premature babies since the p-value is a little higher than the significance level 0, the result of our chi-squared independence test suggests that mothers who smoke more likely to have babies who died in the 1st year.

Contrary to the relationship between smoking habit and premature birth, there is a significant relationship between mother's age and premature birth. older mothers are more likely to have babies premature babies and they are more likely to have babies who died in the 1st year.

To further investigate the relationship between smoking habit and mother's age, and premature birth and gestational age, I fit linear regression and logit models. All variables used in the binary logistic regression analysis were dichotomous.

	Dependent variable:		
	survival of babies		
	OLS		logistic
	(1)	(2)	(3)
Mother's age	0.029***	0.031***	18.130
	(0.003)	(0.003)	(440.646)
Smoking habit	-0.024***	-0.005	-0.140
	(0.004)	(0.009)	(0.475)
Interaction between age and smoking		-0.025**	-17.921
		(0.010)	(440.646)
Constant	0.970***	0.969***	3.436***
	(0.002)	(0.002)	(0.136)
Observations	6,851	6,851	6,851
R2	0.019	0.020	
Adjusted R2	0.019	0.020	
Log Likelihood			-338.686
Akaike Inf. Crit.			685.372
Residual Std. Error	0.104 (df = 6848)	0.104 (df = 6847)	
F Statistic	67.728*** (df = 2; 6848)	47.090*** (df = 3; 6847)	
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:		
	gestational age		
	OLS		logistic
	(1)	(2)	(3)
Mother's age	-0.021***	-0.022***	-0.257***
	(0.008)	(0.008)	(0.094)
Smoking habit	0.010	0.002	0.026
	(0.012)	(0.025)	(0.284)
Interaction between age and smoking		0.010	0.127
		(0.028)	(0.326)
Constant	0.104***	0.105***	-2.146***
	(0.007)	(0.007)	(0.077)
Observations	6,851	6,851	6,851
R2	0.001	0.001	
Adjusted R2	0.001	0.001	
Log Likelihood			-2,069.681
Akaike Inf. Crit.			4,147.362
Residual Std. Error	0.286 (df = 6848)	0.286 (df = 6847)	
F Statistic	3.983** (df = 2; 6848)	2.695** (df = 3; 6847)	
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 1: The effect of age and mother's age on babies survival and gestational age

Fitting the linear model to understand how age and smoking habits affect survival, I find that Model 1 indicates that holding mother's age constant mother's smoking habit (being a smoker) negatively affects survival of babies. Holding mothers' smoking habit constant, being a younger mother 2.9% increases babies' survival chances. The second and third models include the interaction term. Model2 is a linear regression model and the result indicates that the interaction between mother's age and mother's smoking habit is statistically significant at the 0.05 level. When we examine the main effects, we see that mother's age is statistically significant, but smoking habit isn't. Since logistic regression is the appropriate regression analysis to conduct when the dependent variable is dichotomous (binary), we examine the result of logistic regression analysis, and find that neither variables mother's age and smoking habit individually nor their interaction have a significant effect on survival of babies.

Fitting the linear model to understand how age and smoking habits affect gestational age. I find that Model 1 indicates that holding smoking habit constant, I find that mother's age affects gestational age. Which means that older mothers are more likely to have premature babies than younger mothers. The result stays the across three models, it does not matter if we include the interaction term or do logistic regression analysis (Figure 1).

	Dependent variable:		
	survival among premature babies		
	OLS		logistic
	(1)	(2)	(3)
Mother's age	-0.011***	-0.011***	-0.709***
	(0.003)	(0.003)	(0.213)
Smoking habit	0.006	0.006	0.230
	(0.005)	(0.011)	(0.531)
Interaction between age and smoking		0.0004	0.209
		(0.012)	(0.645)
Constant	0.023***	0.023***	-3.757***
	(0.003)	(0.003)	(0.158)
Observations	6,851	6,851	6,851
R2	0.002	0.002	
Adjusted R2	0.002	0.001	
Log Likelihood			-532.580
Akaike Inf. Crit.			1,073.161
Residual Std. Error	0.122 (df = 6848)	0.122 (df = 6847)	
F Statistic	6.603*** (df = 2; 6848)	4.402*** (df = 3; 6847)	
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 2: The effect of age and mother's age on survival among premature babies

Fitting the linear model to understand how age and smoking habits affect survival among premature babies, again mother's age has a significant effect on survival among premature babies. When mothers are older, survival rate among premature babies decreases. It is the case across all different models (Figure 2).

Furthermore, in order to understand more about the relationship between smoking habit and survival among premature babies with older and younger mothers, I develop 4 more models (Figure 3). The results support further our findings in our earlier models (Figure 1 and Figure 2). The effect of mother's smoking habit on survival among premature babies with both younger and older mothers is not statistically significant.

	Dependent variable:	
	survival among premature babies with young mothers	
	OLS	logistic
	(1)	(2)
Smoking habit	0.006	0.090
	(0.012)	(0.175)
Constant	0.072***	-2.563***
	(0.004)	(0.058)
Observations	4,915	4,915
R2	0.0001	
Adjusted R2	-0.0001	
Log Likelihood		-1,274.643
Akaike Inf. Crit.		2,553.286
Residual Std. Error	0.259 (df = 4913)	
F Statistic	0.268 (df = 1; 4913)	
Note:		*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:	
	survival among premature babies with older mothers	
	OLS	logistic
	(1)	(2)
Smoking habit	-0.003	-0.044
	(0.024)	(0.326)
Constant	0.082***	-2.417***
	(0.006)	(0.086)
Observations	1,936	1,936
R2	0.00001	
Adjusted R2	-0.001	
Log Likelihood		-547.274
Akaike Inf. Crit.		1,098.549
Residual Std. Error	0.274 (df = 1934)	
F Statistic	0.019 (df = 1; 1934)	
Note:		*p<0.1; **p<0.05; ***p<0.01

Figure 3: The effect of smoking habit on survival among premature babies with younger and older mothers

4 Conclusion and Discussions

"... a considerable amount of biological evidence supports the view that smoking contributes to adverse pregnancy outcomes. However, mechanisms for the effects of smoking during pregnancy have not been clearly elucidated." (Walsh, 1994)

There were fewer women who were smoking during pregnancy among older that in the group of young women, but the former groups' behavioural risk profile and outcome results demonstrated that older smoking women are a distinct high risk group.

The incremental risk caused by smoking was clearly higher in older than in younger women in all studied outcomes. Even though I do not find significant relationship between smoking habit of mothers and survival of babies and gestational age, the effect exist and the findings of this study are in line with previous studies reporting adverse pregnancy outcomes in smoking women.

One of the limitations of this study is that we do not have the data on mother's weight, other health problems that a mother has which may affect gestational age and survival of babies. Another aspect of the data we should be cautious about is in our sample the study population of the older smoking pregnant women seems to have been positively selected due to their successful pregnancy in spite of the smoking-related risks affecting fertility altogether.

When we evaluate the data, we should be aware of the fact that it has been reported that women who smoke during pregnancy tend to under-report their smoking (Goldenberg et al., 2000) which has significant implications on the validity of research. It is also possible that older pregnant women report smoking more accurately than younger ones (Fox et al., 1994). However, the strength of this study is we have a large enough data set even though the source of the information was not specified.

References

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