

Investigating Associations between PM_{2.5} Exposure and Adverse Birth Outcomes within Alberta's Pregnant Population

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INTRODUCTION

- With air pollution remaining a pressing global concern for individuals, this study aims to communicate a correlation between exposure to particulate matter (PM_{2.5}) and adverse birth outcomes in pregnant populations.

- Air pollution can be traced back to 15,300 premature deaths.¹



- Moreover, the focus of this study is on the air pollutant PM_{2.5} which is the form of air pollution that causes the most fatalities globally. It is made up of particles that are less than 2.5 micrometers in diameter.²

- Consequently, particles smaller than 2.5 micrometers in diameter can bypass the nose and throat, enter the lungs, and in some cases even reach the circulatory system.³

- Existing evidence indicates that PM_{2.5} could induce adverse birth outcomes by decreasing placental blood flow and limiting fetus supply of oxygen and nutrients.⁴

Research Questions:

- What is the association between exposure to PM_{2.5} during pregnancy and adverse birth outcomes within Alberta's pregnant population?
- What is the association of PM_{2.5} and low birth weight?
- What is the association of PM_{2.5} and preterm birth?



METHODS

-A statistic summary was conducted for each confounding variable along with the two outcomes of interest. (i.e. preterm birth and proximity to healthcare) including mean and standard deviation values.

-Hypothesis testing was then conducted to determine the corresponding significance and p value as well as the odds ratio.

-A final logistic regression was then computed to adjust for confounding variables and produce a final model accounting for other factors displaying a new p value.

RESULTS

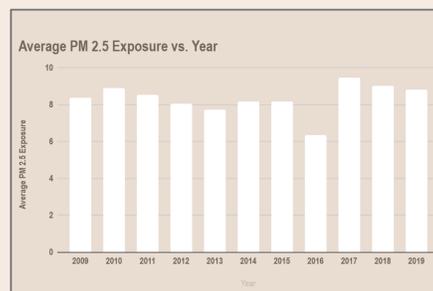


Figure 1.0 PM_{2.5} vs Year

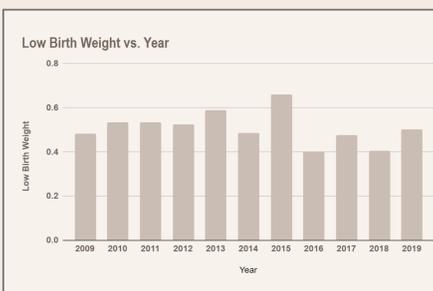


Figure 2.0 Low Birthweight vs Year

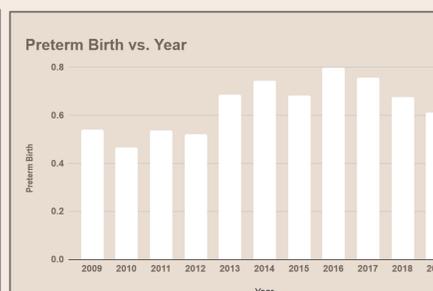


Figure 3.0 Preterm Birth vs Year

Figure 1.0: Yearly Distributions of PM_{2.5} Low Birth Weight, and Preterm Birth

ANALYSIS

Table 1.0 : Adjusted Logistic Model for Association of PM_{2.5} And Preterm Birth

preterm_birth	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]
PM25	1.025772	.0779394	0.33	0.738	.8838438 1.198491
Year					
2010	.7144563	.1455971	-1.65	0.099	.4791942 1.065221
2011	.9110397	.1845892	-0.46	0.646	.6124522 1.355197
2012	.737665	.1641555	-1.37	0.172	.4769117 1.140986
2013	1.810167	.4338393	2.48	0.013	1.131651 2.895506
2014	2.380985	.586202	3.52	0.000	1.469567 3.857658
2015	1.717042	.4326861	2.15	0.032	1.04781 2.813711
2016	3.079301	1.122366	3.09	0.002	1.507301 6.290777
2017	2.555587	.7087078	3.38	0.001	1.484014 4.400919
2018	1.610821	.3764405	2.04	0.041	1.018887 2.546647
2019	1.377881	.3156925	1.40	0.162	.8794054 2.158909
Med_AftTax_Inc	.9999984	1.96e-06	-0.81	0.420	.9999946 1.000002
zone_numeric					
1	1.143776	.2996053	0.51	0.608	.6845009 1.911209
2	8.097609	2.619854	6.46	0.000	4.295008 15.26686
3	6.390621	2.250111	5.27	0.000	3.205078 12.74229
4	.4018465	.1236669	-2.96	0.003	.2198396 .7345384
farfromhealth	.8087651	.1041193	-1.65	0.099	.6284054 1.04089
farfrompark	.9658572	.1430202	-0.23	0.815	.7225543 1.291087
amenity_dense	.4682661	.077212	-4.60	0.000	.3389526 .646914
_cons	1.136468	.8129309	0.18	0.858	.2796927 4.617779

Preterm Birth

1. The adjusted logistic model for preterm birth contains an odds ratio for each variable (i.e. Being further from healthcare indicates being 53 percent times less likely to experience preterm birth.)
2. Contains a p value dictating whether or not a certain variable is significant (i.e., Edmonton is <0.0001 indicating that both Edmonton and Calgary zones are positively associated with higher odds of preterm birth.)
3. Contains a confidence interval for the odds ratio assisting in significance analysis.

Table 2.0: Adjusted Logistic Model for Association of PM_{2.5} And Low Birth Weight

1. The adjusted logistic model for low birth weight contains an odds ratio for each variable (i.e. Being further from healthcare indicates being 1.17 times more likely to experience low birth weight.)
2. Contains a p value dictating whether or not a certain variable is significant (i.e. Edmonton is <0.0001 indicating that both Edmonton and Calgary zones are positively associated with higher odds of low birth weight.)
3. Contains a confidence interval for the odds ratio assisting in significance analysis. The confidence interval that does not include 1 indicates statistical significance.

Table 2.0: Adjusted Logistic Model for Association of PM_{2.5} And Low Birth Weight

low_birth_weight	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]
PM25	5.07e+22	1.43e+24	1.86	0.063	.0601159 4.28e+46
Year					
2010	1.484492	.3609347	1.62	0.104	.9217632 2.390762
2011	2.061171	.6675251	2.23	0.026	1.092563 3.888497
2012	5.653001	2.6142	3.75	0.000	2.283734 13.99306
2013	6.685021	3.763243	3.37	0.001	2.21784 20.15001
2014	7.94065	5.189297	3.17	0.002	2.205906 28.58414
2015	14.12402	10.86222	3.44	0.001	3.128479 63.76514
2016	3.95586	3.381079	1.61	0.108	.7408284 21.12342
2017	3.953137	4.073689	1.33	0.182	.5245447 29.7921
2018	3.333023	3.751986	1.07	0.285	.3669782 30.27167
2019	4.258457	5.278441	1.17	0.242	.375121 48.34296
pm25Year	.9744386	.0135966	-1.86	0.063	.9481508 1.001455
Med_AftTax_Inc	.9999994	2.08e-06	-0.29	0.769	.9999953 1.000003
zone_numeric					
1	1.126562	.3018477	0.44	0.656	.6663262 1.904687
2	.0633557	.018558	-9.42	0.000	.0356824 .112491
3	.0926663	.0291283	-7.57	0.000	.0500448 .1715871
4	4.334281	1.634604	3.89	0.000	2.069665 9.076825
farfromhealth	1.170471	.1685421	1.09	0.274	.8826566 1.552135
farfrompark	.7736181	.1211709	-1.64	0.101	.5691201 1.051597
amenity_dense	2.110123	.4179389	3.77	0.000	1.43125 3.111
_cons	.2101125	.2025151	-1.62	0.106	.0317708 1.389553

CONCLUSION

-Prior to adjusting for confounding variables such as Income, Proximity to Healthcare and Parks, PM_{2.5} was found to have a significant association with the outcomes of Low Birth Weight and Preterm Birth.

-After producing adjusted models, it is observed that the association is no longer significant as seen by a p value of 0.063 and 0.783.

-This displays confounding variables having an impact on the association.

DISCUSSION

- It can be concluded that since there appears to be no significance for Preterm Birth and Low Birth Weight association with Preterm Birth, other factors such as Income and Proximity to Healthcare, Amenities and area an individual live in truly have a greater impact on the wellbeing of an infant.

- However, it is important to note this is looking at PM_{2.5} specifically whereas looking at another pollutant may produce varied results.

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