Women’s Health: Diabetes and Dust Storms

Tsai-Ching Liu

Department of Public Finance and Public Finance and Finance Research Center

National Taipei University, Taipei, Taiwan

Introduction

In parts of the world with significant desert regions, high winds during certain seasons of the year blow grains of sand from the desert into populated areas.

In regions of Asia, Africa, America and Australia, the huge dust storms that form during the winter and spring obstruct sunlight and at times reduce visibility to zero. In Asia, these occurrences are called Asian dust storm (ADS) events.

Due to the spread of dust storms, lots of attention has been paid to whether dust storms will affect health problems.

Literatures have found that dust storms do lead to diseases such as asthma, pneumonia and respiratory disease(Wang et al.,2014; Kang et al., 2012; Dostal et al., 2009; Oftedal et al., 2008).

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Animal and human experimental studies have found evidence linking particulate matter (PM) air pollution with cardiovascular disease (CVD) (Ayres, 2006; Brook et al., 2010).

However, research on the association between dust storms and diabetes is overlooked.

This study is the first to explore the relationship between dust storms events and diabetes hospital admissions.

Methods

1. Data

- This study uses data from National Health Insurance Research Database (NHIRD) of Taiwan.

- We identified all hospital admissions with a principal discharge diagnosis of diabetes (ICD-9-CM codes 250) during the period from January 2000 to December 2009.

- We received the air quality data, including particle density and the average concentration of air pollutants, CO and NO_2, from Taiwan Environmental Protection Agency (TEPA).

2. Methodology

- Since the high PM values last for a couple days after ADS, we hypothesized that ADS would have a prolonged effect on diabetes admissions.
- To capture the lag effect between diabetes admissions and the effects following ADS events, we set up seven dummy variables to control the post-ADS effects from Day 0 to Day 6.
- A time series model was used to investigate the dynamic connection between diabetes hospital admissions and ADS events.

- The autoregressive with exogenous variables (ARX) model we fitted can be expressed as:

- $Dia_t = \alpha + \sum_{i=0}^{6} \beta_i D_i + \sum_{k=1}^{p} \phi_k Dia_{t-k} + \gamma X_t + \varepsilon_t,$

- Here Dia_t is the number of daily Diabetes admissions, Dia_{t-k} is the number of daily Diabetes admissions on the kth day before t, and p is the number of lags.
- The key explanatory variables, D_i, are dummy variables for the ith day after ADS. Here, X_t are the other control variables including temperature, CO, NO_2, season dummy variables (which are spring, autumn, and winter), and a trend. Lastly, ε_t is the error term.

Results

- Table 1 present the demographics of Diabetes hospital admissions. There were 1,283,509 Diabetes admissions during 2000-2009, of which 50.4% were male and 49.6% were female.

- For female, more than 2/3 of Diabetes admissions were aged 45-74 years old.

- The amount of Diabetes admissions peaked on post-ADS day 1 (379.9).
- The male and female groups displayed the same trend, as well as the aged.

Table 1. Average daily Diabetes hospitalization according to gender and age group

	Average daily diabetes inpatient								
	No D	Dust-S	PDday 1	PDday 2	PDday 3	PDday 4	PDday 5	PDday 6	Observations
Total	351.5	347.8	379.9	369.4	369.7	348.8	349.6	342.2	1283509(100%)
Gender									
Male	177.3	176.1	189.1	185.0	184.6	173.8	173.8	170.3	646946(50.40%)
Female	174.2	171.7	190.8	184.4	185.2	175.0	175.8	171.9	636563(49.60%)
Female Age									
45<	12.5	11.8	13.5	13.2	12.8	11.8	12.6	11.4	45574(7.16%)
45-64	61.3	60.1	67.0	64.1	65.2	63.0	59.9	60.5	223805(35.16%)
65-74	54.7	55.6	60.7	60.3	59.6	54.5	56.5	55.6	200251(31.46%)
>74	45.8	44.2	49.6	46.8	47.7	45.6	46.8	44.5	166933(26.22%)

No D: No dust-storm; Dust-S: Day of dust-storm; PDday 1: Post-dust day 1

Table 2 reports the regression results of ADS events and other covariates affecting the number of Diabetes hospitalizations based on the total population and on male and female populations.

The result based on the total population (column 1) showed that, after controlling for daily temperature and air condition, season, time trend, and potential autocorrelation, there was no significant occurrence of Diabetes admission on ADS event days. However, the number of Diabetes hospitalizations significantly spiked on post-ADS day 1. Among the total population, 27.4 more cases of Diabetes admissions occurred on post-ADS day 1 ($p<0.05$).

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When breaking down the population by gender, columns 2 and 3 in table 2 showed that a day-1 post-ADS lag effect existed in the female population, but not in the male population. Among females, 14.2 more Diabetes cases emerged on post-ADS day 1, holding other factors constant.

Table 2. ARMAX regression analysis for the relationship between dust-storm and number of daily Diabetes admissions according to gender

Independent variable	number of daily Diabetes admissions								
	Total			Male			Female		
	B	SE	P value	B	SE	P value	B	SE	P value
Intercept	261.1918	35.396	0.000 ***	129.1209	18.940	0.000 ***	132.0771	16.995	0.000 ***
Trend	0.0069	0.003	0.007 **	0.0061	0.001	0.000 ***	0.0008	0.001	0.513
Temperature	1.8797	0.655	0.004 **	0.9660	0.351	0.006 **	0.9113	0.316	0.004 **
CO	-56.7908	33.145	0.087	-30.9251	17.732	0.081	-25.8693	15.877	0.103
O3	-0.4305	0.597	0.471	-0.2651	0.319	0.406	-0.1670	0.286	0.559
NO2	4.1123	1.059	0.000 ***	2.0951	0.567	0.000 ***	2.0198	0.507	0.000 ***
Time since dust-storm									
Day of dust-storm	-5.6026	9.309	0.547	-0.7143	4.984	0.886	-4.8170	4.503	0.285
Post-dust day 1	27.4130	13.324	0.040 *	13.2540	7.138	0.063	14.2362	6.509	0.029 *
Post-dust day 2	14.8126	14.053	0.292	7.5888	7.528	0.314	7.2891	6.856	0.288
Post-dust day 3	13.6906	14.238	0.336	6.2328	7.627	0.414	7.5317	6.945	0.278
Post-dust day 4	-6.2741	14.784	0.671	-4.3446	7.920	0.583	-1.9184	7.213	0.790
Post-dust day 5	-3.0172	14.827	0.839	-3.0721	7.944	0.699	0.0374	7.243	0.996
Post-dust day 6	-19.3391	12.040	0.108	-10.7586	6.449	0.095	-8.2909	5.854	0.157
Summer	-3.0992	9.306	0.739	-2.3714	4.979	0.634	-0.7006	4.461	0.875
Autumn	-13.9746	6.221	0.025 *	-7.8760	3.328	0.018 *	-6.0782	2.980	0.042 *
Winter	-1.6910	7.298	0.817	-1.9811	3.905	0.612	0.2803	3.503	0.936
AR1	0.2462	0.016	0.000 ***	0.2448	0.016	0.000 ***	0.2277	0.016	0.000 ***
AIC	11.7343			10.4867			10.3084		

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Table 3 further presents the results for the female population stratified by four age groups. In table 3, we observed that the post-ADS day 1 effect occurred in the female aged 45-64 and older than 74.

Among the female aged 45-64, 5.4 more cases of hospitalizations occurred on post-ADS day 1. Among female older than 74, 4.3 more cases occurred on post-ADS day 1.

Table 3. ARMAX regression analysis for the relationship between dust-storm and number of daily Diabetes admissions according to different female age group

	number of daily Diabetes admissions											
	Female <45			Female 45-64			Female 65-74			Female >74		
	B	SE	P value	B	SE	P value	B	SE	P value	B	SE	P value
pt	11.4079	1.638	0.000 ***	49.3007	7.065	0.000 ***	49.2880	5.710	0.000 ***	21.9987	4.210	0.000 ***
	0.0002	0.000	0.068	-0.0016	0.001	0.002 **	-0.0024	0.000	0.000 ***	0.0046	0.000	0.000 ***
rature	-0.0032	0.031	0.918	0.3858	0.131	0.003 **	0.2421	0.107	0.024 *	0.2827	0.080	0.000 ***
	-0.4136	1.510	0.784	-12.8617	6.608	0.052	-7.7662	5.310	0.144	-4.9159	3.890	0.206
	-0.0289	0.027	0.289	-0.0522	0.119	0.661	-0.0974	0.096	0.309	0.0062	0.070	0.929
	0.0740	0.048	0.126	0.7296	0.211	0.001 **	0.6132	0.170	0.000 ***	0.6140	0.124	0.000 ***
ince dust-storm of dust-storm	-0.5095	0.454	0.262	-1.9570	1.865	0.294	-2.0593	1.535	0.180	-0.1757	1.156	0.879
-dust day 1	1.1318	0.707	0.110	5.4290	2.683	0.043 *	3.7236	2.265	0.100	4.3321	1.771	0.015 *
-dust day 2	0.8855	0.739	0.231	2.0149	2.828	0.476	3.2230	2.380	0.176	1.3735	1.853	0.459
-dust day 3	0.5027	0.748	0.502	2.9375	2.865	0.305	2.3615	2.410	0.327	1.9405	1.876	0.301
-dust day 4	-0.4244	0.777	0.585	1.0223	2.975	0.731	-2.2303	2.504	0.373	-0.1989	1.950	0.919
-dust day 5	0.3930	0.786	0.617	-1.5469	2.986	0.604	0.0709	2.520	0.978	1.1319	1.970	0.566
-dust day 6	-0.9548	0.609	0.117	-2.7327	2.419	0.259	-2.2686	2.015	0.260	-1.6515	1.542	0.284
er	0.8132	0.426	0.056	0.7088	1.856	0.703	-0.9241	1.494	0.536	-1.1923	1.096	0.277
n	0.3458	0.284	0.223	-0.4949	1.240	0.690	-2.0961	0.997	0.036 *	-3.7638	0.731	0.000 ***
	-0.0052	0.337	0.988	-0.1716	1.456	0.906	-0.8510	1.176	0.469	1.3258	0.866	0.126
	0.0978	0.017	0.000 ***	0.2368	0.016	0.000 ***	0.1898	0.016	0.000 ***	0.1262	0.016	0.000 ***
AIC	5.9014			8.5326			8.2095			7.7327		
SC	5.9303			8.5615			8.2385			7.7616		
R^2	0.0166			0.0763			0.0840			0.1678		

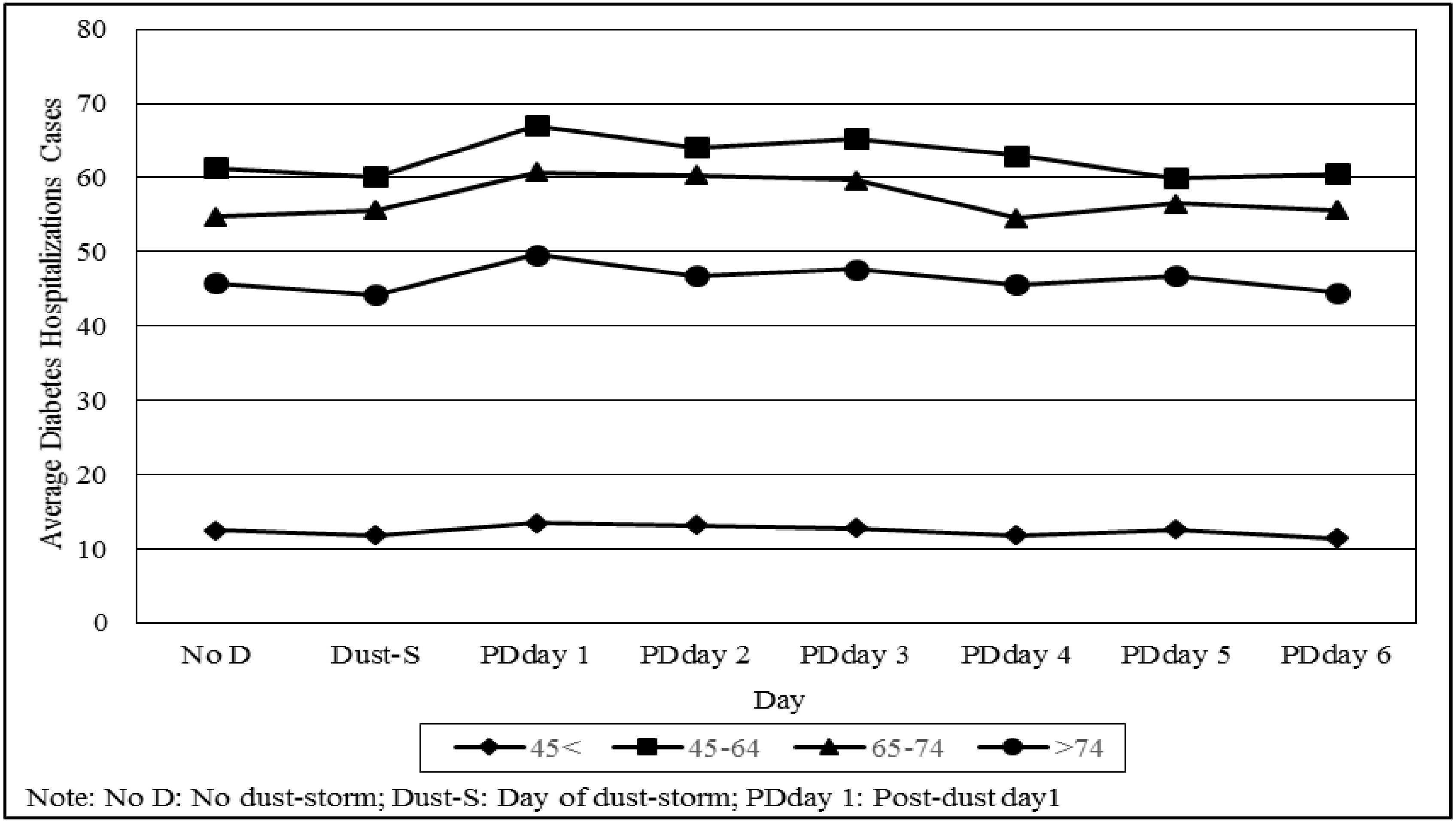

Figure1. Average daily Diabetes hospitalizations by female with different ages

- **Conclusion**

- **The results show that a dust storm event leads to an increase in the number of diabetes hospital admissions, but the effect is delayed rather than immediate and is presented for women only.**

- **After controlling for daily temperature and air condition, season, and time trend, we find that dust storms event days do not result in a significantly higher number of diabetes hospital admissions.**

- However, a significantly 14.2 more cases of diabetes admissions are exhibited on the first day after a dust storm event for female.
- When the data are further stratified by age, the same delayed effect is present in those female aged 45-64 and over 74.

- The prevention and control of diabetes is important since diabetes is related to fatal diseases such as heart and kidney failure. Our study shows that although a dust storm event does not cause an immediate incidence of diabetes hospitalizations, it does induce diabetes hospitalizations for women through a delayed effect.
- Women with diabetes should be extremely careful and avoid outdoor activities after dust storms occur.

- Thank you for your attention